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THE AMERICAN GAS LIGHT JOURNAL

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CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told..... 417

A Cincinnatian who Knows whereof He Speaks—The Montreal Trouble with Impure Gas—A Ruffled Expert—An Explanatory Letter from Mr. Enfer—Illness of Mr. H. Felt—Mr. Page to Introduce the Harcourt Standard.

Experiences and Observations, by A. C. Wood..... 419

On the Working of a Combination of Gas and Electricity in a Neighboring Town, by R. B. Taber..... 419

A Review of Patents Invented and Inventions Patented in the Gas Interest the Past Year, by F. Egner..... 420

Artificial Stones..... 421

*The Guide-Framing of Gasholders: How, and How Far, May It be Dispensed with, by Geo. Livesey..... 422

Economy in the Production of Artificial Light, by N. H. Humphrys 424

A Special Air Supply for Gas Burners, by N. H. Humphrys..... 425

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 427

How San Antonio (Texas) Might Secure better Light—A Hint from Concord, N. H.—Cost of Lighting the City Hall, Boston, Mass.—Toronto Tries to Frame a New Ordinance—Expectations at Kenosha, Wis.—Queer Custom at Philadelphia—Death of John R. Fenniman—The Welsbach Company's Successful Shade Competition—New Gas Company—Shall Milwaukee (Wis.) Operate a Municipal Lighting Plant?—A Gas Ordinance for Lincoln, Neb.—An Electrical "Deal" at Evansville, Ind.—Mr. Converse Goes to Pomona, Cal.—Something from Troy, N. Y.—The Ross Machines at Philadelphia—Additions to the North Adams (Mass.) Plant—And Galena, Ills.—The St. Louis Gas Commission Ready to Report—Public Lighting, Pittsburgh, Pa.—Electric Lighting Inequalities, Utica, N. Y.—A Station Meter with a Record—Cost of Public Lighting, Baltimore, Md.—And Many other Items.

Gas for Coal as Fuel..... 430

CORRESPONDENCE—

"W." Coincides with Mr. Somerville..... 431

The Market for Gas Securities..... 432

BRIEFLY TOLD.

A CINCINNATIAN WHO KNOWS WHEREOF HE SPEAKS.—Of course, we ask at the outset to be absolved from intending in the foregoing caption to convey an impression that this particular resident of Cincinnati is the only one in that city who does know whereof he speaks, for the Paris of America abounds in examples of those who can tersely and understandingly discuss almost any subject, once a starting point be granted them. Hence we do not imply that other Cincinnatians are dull simply because we happen to assert that General Andrew Hickenlooper is particularly and lastingly brilliant, and with this as preliminary, we wish to call the especial attention of our readers to the reproduction* of an interview recently held between the President of the Cincinnati Gas Company and a reporter of the *Commercial Gazette*, the subject under review being, to put it concisely, "Gas for Coal as Fuel." Those who are fortunate enough to enjoy close personal acquaintance with this military gas man need not be told of his striking personality, and we would go further in an attempt to reveal some of the traits which hint at the real character of the man, were it not that some of our "friends" might hint that we had a favor to ask from the General at some time in the near future. Again, those personally unacquainted with him, but who have carefully watched the course of the gas industry in this country during the last decade, must nevertheless know something about him; for once in a while they must have heard an occasional clarion blast from the trumpet of his opinion. We might have expressed, in much fewer words, the idea that we started out to convey, which was simply that when Gen. Hickenlooper did address himself to any subject his expression of the subject matter was apt to be clear cut and comprehensive, and so, worth close study. His remarks on the subject of artificial fuel gas, and the direction to which we must look for its advent, are respectfully referred to the attention of those honestly and earnestly engaged in the attempt to solve by invention the groundwork of the problem, and also to the capitalists, who, buoyed up by the vision of golden profit that is to come to the solver, having loaned in the past are lending in the present the funds needed to carry on the struggle. If there is any city in the world that is close to the realization of the dream of cheap artificial fuel gas that city is the one in which General Hickenlooper resides, and he and his adjutants are those who shall receive credit for the victory. Nor will they have achieved the same by any forced marches after will-o'-the wisps. Ordinary common sense practice (assisted greatly by the power that has held in check the lavishness of city councils in the matter of granting gas charters) has all but opened the field of artificial fuel gas distribution to the gleaning of the local gas Company, and we venture the prediction that the ensuing decade will witness the general distribution of fuel gas, made from coal, and carbonized in retorts, from the works of the Cincinnati Gas Light and Coke Company, and that this supply shall be made at a figure alike profitable to the Company and palatable to its consumers.

THE MONTREAL TROUBLE WITH IMPURE GAS.—The Associated Press agent in charge of that miserable monopoly's business in Montreal, Can-

*Page 429.

ada must cherish a deeply rooted grudge against the managers and proprietors of the Montreal Gas Company; for he never misses an opportunity to spread before the world grossly exaggerated accounts of any accident or mishap that may vex the minds of the one or threaten the pockets of the other. Last spring when the new and huge holder collapsed—the disaster it is true was sufficiently shocking in its results if only the bare truth were told about it in description—the agent fairly outdid his vivid imagination. One would suppose from the first fables sent out that the portion of Montreal that was not wringing its hands in sorrow over the killing of a relative was engaged in binding up its wounds; or that the buildings which the concussion had not thrown down remained standing simply because they had been promptly and properly shored. The London *Journal* often feelingly complains (perhaps, though, that authority—and authority it is—too frequently approaches its chair of criticism when the approacher is weighed down by the reflex of a recent drastic dose) of the proneness of the secular press to over-print, and we humbly admit that ourselves (as well as Montreal) have had cause to suffer from it in this respect. Still, frequent lying chills the truth, and now we are content to murmur not when only half the truth is told, being but spurred to discontent when the truth is simply overlaid in twice its weight of lies. This last condition applied to Montreal in May, 1888, and it also applies to the recent trouble, as described by our contemporary, the Associated Press man, of about a fortnight ago. He, in his enthusiasm (or hatred), said the gas sent out by the Montreal Company on a certain occasion was so foul that some, while walking along the streets, were stricken through having inhaled the products of its combustion—from the street burners, we suppose. We are in position now, however, to explain the cause of the "bad gas" at Montreal, and the explanation also furnishes testimony as to the wilful mendacity of the news agent in one of Canada's most charming cities. Without further ado we submit the following:

THE MONTREAL GAS COMPANY, MONTREAL, Dec. 11, 1888.

To the Editor AMERICAN GAS LIGHT JOURNAL:—Yours, of the 7th inst., to hand, requesting an explanation of the difficulties experienced by this Company recently with the supply of gas.

On Saturday (1st inst.) we charged for the first time our new retorts at the Hochelaga station, heated by the regenerative furnaces. Gas men will readily understand that these furnaces do not always start off smoothly at first. Some of the fittings were not sufficiently tight, hence a sufficient quantity of air was drawn into the apparatus to fire two of the oxide purifiers, and almost before the trouble was noticed the gas in our largest holder and in the street mains was charged with sulphur.

It is needless to add that every exertion was put forth to speedily remedy the evil. The purifiers were turned off, retort lids opened, manufacture reduced to a minimum, and the bonnet covers in the large holder raised sufficiently to allow the foul gas to escape in the air.

The accident happening at only one of our stations, only a portion of the city was supplied with the impure gas. The difficulty was remedied in a short space of time; but, unfortunately, the gas in the street mains became impregnated, and as it was beyond our control the consumers were forced (reluctantly on their part as well as our own) to use the impure article.

I am happy in being able to state that we have regained our usual equilibrium, and our new furnaces are giving great satisfaction. The self-sealing lids are working to perfection. This for the benefit of Messrs. Harbison and Somerville. Yours truly,

J. F. SCRIVER, Sec. and Manager.

A RUFFLED EXPERT.—We are also in receipt of a communication from Mr. Fred. H. Whipple, whose note paper bears the imprint "Electrical Publications," with the further announcement that his headquarters are in Detroit, Mich., with branch stations in Chicago, New York, and Boston. From this it will be seen that Mr. Whipple appeals to the residents of a large section of the country. Mr. Whipple's communication to us was inspired by the article in our last that referred to "Municipal Lighting," and we are now indebted to him for our primal knowledge that he was the expert who furnished the figures respecting the cost of the establishment of a municipal electric lighting station at Bangor, Me. Since Mr. Whipple has to do with "Publications," he will of course comprehend our reason for omitting to publish some of his introductory remarks; and with that understanding we hasten to place before our readers the gentleman's explanation of the Bangor estimate. Mr. Whipple says:

"The estimate of $17,000 at Bangor was based upon an electric light plant of 125 arcs capacity, and included the electrical plant only. The estimated cost of operation was $32.20 (not $23.20, as you incorrectly stated), and this did not include power, labor or interest. Why these estimates were prepared without reference to the items I have mentioned was well understood by those who employed me, and a measure of understanding should have been yours before you went out of your way to call me names."

Once more alluding to the fact that Mr. W. has to do with "Publications," we have to say that odd errors will escape even the best of proof readers, and that the types in the $23.20 instance were simply misplaced. As to the balance of the explanation, if Mr. Whipple is satisfied therewith, why, we must also be. Still, we are content to let it go before our readers, to be taken by them in connection with our prior comments on the subject.

THE following letter explains itself:

SUPERINTENDENT'S OFFICE, EQUITABLE GAS LIGHT CO.,
FIRST AVE. AND FOURTEENTH ST., NEW YORK, Dec. 5, 1888.

To the Editor AMERICAN GAS LIGHT JOURNAL:

In your issue of Dec. 3, page 381, I read a report in reference to a broken main, on 37th street near 1st avenue, which does great injustice to the men employed by this Company. The facts are as follows:

The contractor for the Standard Gas Company in blasting did break a 6-inch main of the Equitable Gas Light Company. The 20-foot flame did not exceed 15 inches; the blaze lasted about 5 minutes; amount of damage, $9. Very respectfully, E. J. ENFER, Supt.

[We are obliged to Supt. Enfer for his courteous correction in furnishing a plain statement of the facts; and must confess that had the offender been properly named to us in the first instance we would not have mentioned the occurrence at all. Now there is no cause for wonder about it; in fact, it might have been expected. The paucity of the damage figure, however, does not in any degree lessen the showing of carelessness made by those who were really at fault. And it is not contradictable that blasters who operate in this city are noted for their contemptuous disregard of real property that is buried beneath the pavements.]

IT is with extreme regret that we chronicle the illness of Mr. Henry Felt, the Superintendent of Distribution of the Cincinnati Gas Light and Coke Company, who, it is feared, is in for a siege of that insidious enemy—typhoid fever. To still more greatly depress him came the shock of losing his only daughter, a lovely young woman, who was united in marriage last March to Mr. Edward C. Havemeyer. The sufferer has the sincere sympathy of his fellow craftsmen, who will watch with anxiety for the news of his speedy and complete recovery.

MR. GEO. SHEPARD PAGE, of 69 Wall street, city, with that nice business acumen which fits him so well, informs us that he has succeeded in perfecting arrangements with the Hon. A. Vernon Harcourt (London, England), whereby our Wall street friend will have the right to introduce the Harcourt improved "Pentane Standard Lamp" to the notice of the gas makers of the United States and Canada. We further understand that the lamp will be manufactured by American workmen out of home material. Although the figures have heretofore appeared in our columns, we herewith reprint a statement concerning the relative value of the pentane standard over those with which it was compared. From the large number of tests made the following were within 1 per cent. of the mean:

Pentane lamp	97	Amyl-acetate	90
10-candle test	88	Methven	74
Keates' lamp	39	Candles	34

THE Trustees of the St. Louis Gas Trust agreement, holding the stock of the St. Louis and Carondelet Gas Light Companies, met on Dec. 3 and re-elected the old Board of Directors. Those in the St. Louis Company are Messrs. Thomas E. Tutt, George W. Fishback, Charles T. Turner, Dwight Durkee, and W. H. Thompson. The latter was also re-elected President, with John R. Lionberger as President *pro tem.*, and George Paschall as Secretary. The Directors in the Carondelet Company are Messrs. John R. Lionberger, George A. Madill, John Scullin, and Henry C. Scott, the former also being elected President, and the latter was chosen Secretary. An important feature of the St. Louis Company's meeting, in which there is some stock not in the Trust, was the reading of the report of President Thompson recommending the erection of holders in the western part of the city, to double the present capacity; and also a new retort house.—*Globe Democrat.*

THE adjourned hearing on the application of certain companies for the right to manufacture water gas in the State of Massachusetts has, with the consent of the Commissioners, been postponed to Jan. 17, 1889.

R. D. WOOD & CO.

Office: 400 CHESTNUT STREET, PHILADELPHIA, PA.

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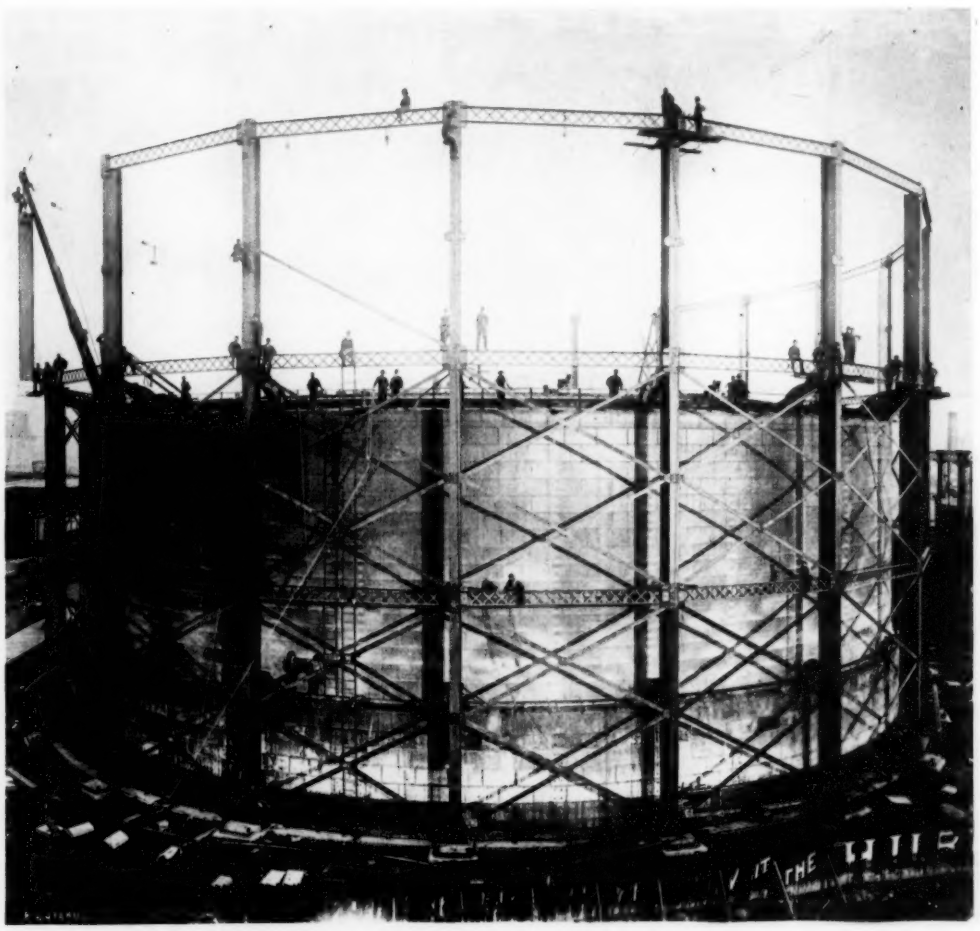
TAYLOR'S REVOLVING BOTTOM GAS PRODUCER.



THREE LIFT GAS HOLDER

IN COURSE OF ERECTION AND SINCE COMPLETED FOR

People's Gas Light and Coke Company.

Tank, ... 184′ 8″ diameter x 42′ 6″ deep.
Outer Section, 181′ 11⅜″ " x 42′ 6″ "
} CAPACITY 3,100,000 CUBIC FEET {
Middle Section, 179′ 0½″ diameter x 42′ 6″ deep.
Inner Section, 176′ 1⅝″ " x 42′ 8¼″ "

The above Phototype shows this Holder with the three sections completed and raised by air so as to serve as a support for the engine and derricks used in the erection of the frame,—which consists of twenty built up columns, connected together by four tiers of latticed girders. The crown is spherical, non-trussed with 7′ 8¼″ rise,—the grounding support being of wood. The cups are of Piggot's style,—10⅝″ wide x 18″ deep inside.

Single Lift and Telescopic GAS HOLDERS with WROUGHT IRON TANKS, a specialty.
Four built this year.

[A paper read before the Society of Gas Lighting.]

Experiences and Observations.

By Mr. A. C. Wood.

"Experiences and observations" seem to be the order of the day; for no less than three papers with that heading were presented to the members of the American Gas Light Association at its recent meeting at Toronto. And if this writing shall assume the dignity of a paper, I shall have saved my credit, and also the fine which our worthy secretary would gladly impose upon me.

At the fifth annual meeting of the American Gas Light Association (held in Cincinnati, Ohio, October 17, 1877) the late Major Dresser read an interesting paper on "Naphthaline." During the discussion that followed the reading of that paper I remarked, "I would like to know how general this complaint (stoppage of pipes with naphthaline) is? We occasionally have some in our service pipe, but are not seriously troubled with it."

Up to that time we had experienced but very little trouble with naphthaline, say, ten or twelve complaints of stopped service pipes being the maximum number in a single night—usually not one-half of that number of complaints came to us—these occurring during the change from fall to winter season, and extending over a period of two to three weeks only. And, too, up to that time we had experienced no stoppages of pipes about the works from this cause. Yet we were running with high heats, making a yearly average of five feet of gas to the pound of coal used.

With heats sufficient to produce that quantity of gas from the coal we experienced that other inevitable result and vexatious trouble, "stopped stand-pipes."

These experiences were continued in the way described until sometime during the year 1878, when, on a visit to the gas works at Cortland, N. Y., I found the foreman at those works successfully introducing a small quantity of water into the stand-pipes as a remedy against stoppages. I was so thoroughly impressed with the success of the plan that I at once proceeded to introduce it into our Syracuse works. This was accordingly done by syphoning a small quantity of water inside the pipe in such a manner as to wet the inside surface of the pipe only. This proved very effective. Before using the water we had recorded 1,005 stopped stand-pipes in 60 days; after the introduction of the water we had only five stopped stand-pipes during the same length of time.

You will remember that up to this time (1878) we had practically no trouble from naphthaline, and by the use of the water we got rid of stopped stand-pipes, and were happy.

From about this time on (I had no record of exact date) our trouble about the works from pipes stopped with naphthaline commenced. The first pipe stopped was the 6-inch inlet to our No. 1 holder. This pipe, extending from the station meter connection, ran through an arch under a stack of benches. The pipe within the arch was quite hot, and, concluding that the heat had much to do with the deposit of naphthaline in the pipe, we broke the connection and carried the pipe underground, around outside the end of the retort house to the holder, and received some relief by so doing, the stoppages not being so frequent as before.

We were also troubled with stoppages in the 12-inch inlet to No. 2 holder. This inlet pipe has a short connection from station meter of about 30 feet to holder; but our most serious trouble was in the 20-inch inlet to our No. 3 holder. This pipe ran from the station meter through a cellar, about 75 feet, thence (underground) 100 feet to the holder.

The excavations for all of these tanks were in gravel, extending down into cold spring water, the water standing at about 50° F., consequently the inlet pipes to these holders lay in the cold water below the concrete bottom of the tanks. From time to time these pipes would fill up with naphthaline, but the 20-inch pipe more often than the others. After a time we found, by throwing our whole make of gas into No. 3 holder, and feeding the others from it, that we almost entirely stopped the gathering of naphthaline in the inlets of Nos. 1 and 2, and apparently with no increase of it in No. 3. This state of things continued, and we were obliged to clean out No. 3 inlet, say, 4 or 5 times a year.

In 1884 we built an extensive enlargement to our works, and placed a new station meter in a new location, bringing it to within 70 feet of the inlet to No. 3 holder. Then the circus commenced. That 20-inch inlet pipe to No. 3 would fill up full of naphthaline, without the slightest provocation or inducement on our part to have it do so. We were obliged to clean it out on an average of once a month. We continued to run our whole make into No. 3, as before, with no change in the conditions except to shorten the length of pipe from meter to holder; but there was an increased make of gas.

Now comes in a new condition of things with new developments.

In September, 1887, the foreman of our works, being on the top of a stack of benches, removed the covers of some of the stand-pipes and found considerable of a deposit of naphthaline on the covers. Continuing his examination over the stack, he found on the cover of every stand-pipe into which we were running water quite a quantity of naphthaline, while in some of the pipes where the flow of water had been temporarily discontinued, no naphthaline was found on their covers. We immediately discontinued the use of water in the stand-pipes, and from that time to the present we have had but little trouble from naphthaline about our works, and but very little in the street service pipes.

During the year 1887 we erected a new 100 by 40 foot holder, which was put into use on the 15th of December of that year, the excavation for the tank being into similar material as described for the other tanks. As a matter of precaution, to protect the inlet and outlet of this holder from contact with the cold spring water, we encased the 20 inch pipe with a brick and concrete covering, 24 inches thick. Most of the time since putting no 4 in use we have run our make of gas into it, feeding the other holders from No. 4, or as we had previously worked No. 3.

Soon after discontinuing the use of water in the stand-pipes we cleaned out the inlets to No. 2 and 3 from previous deposits. No. 2 has not since been cleaned, and No. 3 but once up to the present writing, say, from 14 to 15 months—No. 1 not having been cleaned since discontinuing the water.

We found it necessary to clean out the inlet to No. 4 sometime in January last, or in about 30 days after the holder was put into use. Since that time there has been no indication of a deposit of naphthaline in that pipe, until within about 30 days, when a slight back pressure showed that naphthaline had begun to gather. This we attribute to the fact that our supply of cannel had run short in consequence of delay in the railroad to deliver it, and for about 10 days we could not use our usual amount of 5 per cent. of cannel. On the receipt of cannel we doubled up the quantity used to 9 or 10 per cent., and the naphthaline already deposited in the pipe seems to be gradually taken up, as the back pressure has been reduced.

Our gas leaves the station meter at 60° F. The temperature in the arch under the stack of benches through which the inlets of No. 1 holder passed was, say, 130° to 150° F. There is undoubtedly an underground stream of water constantly flowing around and in contact with the inlet and outlet pipes of all our holders, this water standing at 50° F.

We have never had stoppages in the outlet pipes of these holders, nor in any pipes about the works, except those mentioned.

Conclusions.—My conclusions, derived from these "observations and experiences," are:

1. The fact that has been fully demonstrated by others is clearly confirmed by these experiences, that a sudden shock to the gas, from change of temperature to either heat or cold, will develop naphthaline.

2. The introduction of water in small quantities will prevent "stopped stand-pipes."

3. The introduction of water into the stand-pipes will (it did unquestionably with us) promote the development of naphthaline.

Remedy.—For a solution of these troubles and a remedy for naphthaline stoppages and stopped stand-pipes, I would suggest that the matter be referred to the committee of the whole to report so soon as any one of the members finds out the remedy.

[A Paper read before the Society of Gas Lighting.]

On the Working of a Combination of Gas and Electricity in a Neighboring Town.

By Mr. R. B. Taber.

One word of apology. As so many of my superiors are better posted it becomes a hard matter to avoid "chestnuts." May I ask you to interrupt me when I strike shoal water. My purpose, of course, is to illustrate briefly the working of a combination of gas and electricity in a neighboring town.

The original plant was taken over in March last, consisting of six Thomson-Houston arc dynamos, nominally 192 arc capacity, actually running 135, and 3 boilers (Jarvis setting), of the same capacity, with lines and poles and lamps, but on leased land, for which payment was made at the rate of $325 per lamp. During the preceding months the profits had hardly equalled 3 per cent., and the problem was to so economize in labor, increase and efficiency that interest at 5 per cent., and a dividend at 8 per cent., in equal proportions, might be paid, satisfactory depreciation might be charged off, even on the face of an active competition; and all this without detriment to existing gas interests. To economize in labor and loss by friction was to enlarge the plant; to economize in efficiency was to add incandescent and power circuits;

which would necessitate the constant running of the station the week through.

Of course, the only practical development in municipal incandescence applicable to any point in a city extending two miles by four miles was the alternating circuit. Nothing less capable of easy distribution to every section of the territory was feasible. As a matter of fact, anticipating my story a little, two No. 6 wires were sufficient, at a distance of two miles, to do the work of six 00 wires then in use on the direct 3-wire system. But around this alternating current the "Red Book" had hung many jack-o-lanterns and first danger of distribution. We squelched this by the employment of simplex wire, safe almost to handle in dry weather and easily regulated, by the switch system, in necessary converter connections, in wet days.

Another objection was, the converters themselves; said to be unreliable and unsafe, since the high tension current would leap the fuses and transfix the credulous subscriber. We set up 146 of these dangerous things, and thus far have replaced one, which was found imperfect as it came from the maker.

But perhaps, since more unknown, the worst source of danger was apprehended from contact with static electricity, since the alternating current has (I quote from my authority previously mentioned) a high attraction for the lightning. To meet this a higher attraction was provided by earth grounds at the dynamo; and I am glad to say that in the midst of one of the worst lightning storms which visited us in our section last summer this counter attraction was abundantly sufficient. At the same time, to doubly guard the house connections, all inside wiring was done with a good insulated wire—that of the Eastern Cable Company—and all fittings were of the best attainable.

The only serious trouble yet left was the lamps themselves; which, as furnished by the "Parent Company," are variable in quality and not yet entirely satisfactory, partly from our inability, partly from too rapid increase, to keep a constant pressure, partly from a weakness in the lamps themselves. However, armed and equipped with the special fostering care of the "Parent Company," with two dynamos ready to supply any breakdown, and a switch-board cut up into seven independent circuits, we "let her go" on the 4th of May, and stood back to see the "wheels go round."

Things went round; the lamps were whiter than our competitor's. The "Hoi polloi" liked the contract system. By June 1st we had 377 lamps in operation, and June 15th we sent another order for a dynamo, and an Armington & Sims' double-cylindered engine of 120-horse power; and were by July 16th equipped with three 650-light machines. To economise for the day consumption we now ran a power generator, 50-horse power, picked up about 15 to 20-horse power in motors, and expected no more for the winter.

The feeders on the circuit were then calculated as follows:

Length out and in.					
1.—4,200	feet, for	700	lights, No.	2	wire.
2.—9,800	"	215	" "	4	"
3.—9,000	"	170	" "	5	"
4.—6,900	"	280	" "	4	"
5.—9.000	"	200	" "	6	"
6.—8,000	"	380	" "	5	"
7.—4,000	"	700	" "	2	"
8.—2,000	"	150	" "	10	"

A total of 2,605 lights, with an average drop of 2 per cent. on feeders, while the mains and services were run from their feeder ends in sizes from 5 to 10, according to carrying capacity and length required.

By October 25th the number of lamps wired had risen to 1,950; the maximum load, 1,700; and the arc machines were supplying a maximum of 175 lights. The increase in the efficiency section of the problem had now become burdensome. Two other engines, one 120 and one 150-horse power, one more alternating current machine, one 150-horse power boiler, and one arc machine were ordered, and will be ready to relieve the strain on mind and engine on Thanksgiving Day. We hope we are prepared for the winter.

The success was evident, however. A white light, satisfied customers, no fault-finding, no pulsation, no difficulty in keeping up candle power, little blackening of the lamps. Mechanically there was little more required—nothing now but to pay the bills and add or subtract the losses. In fact, 67 lights 2 miles away are as thoroughly under control and efficient as if on the block beside the office.

The cost of equipment up to October 15, say 2,000 lights, makes a total investment of about $100,000 on which to pay capital charges and depreciation. Yet we have a new building contracted for, with engine and boiler of 1,200 horse power, to be ready in the spring of 1889.

Now, does it pay? And the answer to this depends on local circumstances—the method of sale and the depreciation charge. We were involved in an extremely sharp competition with an electric company which was endeavoring to underbid gas and selling by meters. We forced their hand by accepting the contract system, based on gas rates in similar kinds of business, at a net rate of $1.80 per thousand, often falling to $1.50 to meet the wholesale discount. We might have had recourse to meters, too—there is a meter; but we might also have had the usual complaint over a meter without feeling the assurance of a gas man over his much derided pet. We, therefore, let meters alone and sold by contract, feeling our way. As to depreciation, we allow that to rest until we know more what it is. So far, $450 covers the repairs in a six months run. What is in store in the future, or what has happened since I left home, you and I simply can't tell. We further made no charge for wiring stores, which we allowed to go into construction. It was wise policy under local circumstances, and gained our point.

[First Article.]

A Review of Patents Invented and Inventions Patented in the Gas Interest the Past Year.

By Frederic Egner.

As a general rule, with few but honorable exceptions, patentees are fully convinced, for the time being, that their particular hobby is just the thing the world has been waiting for; and they regard as either personal enemies, ignoramuses, or envious and jealous persons all those who dare to doubt or question the wisdom of their (the patentees') views. As for those who, after having exhibited the patience and good nature to listen to all that such a would-be inventor had to say, and still remain unconvinced—to quote from the well-known "Mikado"—"their fate would be extremely hard" if the disappointed crank could have his way about them. But as it is our great American privilege to not only think, but also to say and write what we please, so long as we do it without malice and keep within the bounds of truth and propriety, each human being may hold and express an opinion (keeping within the proper boundaries previously mentioned) even as to the subjects of patents. In that spirit the writer of this article proposes to review the patents of the past twelvemonth—and maybe even of an earlier date—hoping thereby to interest the readers of the Journal, and perhaps benefit some of them.

In carefully looking over the copies of the drawings and the specifications accompanying each patent, we can arrive at tolerably fair conclusions as to the practical value (outside of what the patentee may get or expect for it) of the subject of the same. In some cases the conviction is irresistibly forced upon an impartial and thoroughly posted investigator that the appellation of the patent would be nearer the truth to say it was for "a patent invented" than "an invention patented." But let the reader judge for himself as he proceeds.

In the twelvemonths ending Nov. 15, 71 patents were issued by the U. S. Patent Office for apparatus used in making and distributing illuminating and fuel gas. As near as the writer was able to classify the subjects of the said 71 patents, these were as follows:

For making gas from oil, water, and air	2
For making gas from oil and steam	10
For making gas from coal, oil, and steam (water gas)	17
For making gas from rosin	1
For making gas from coal	2
Carburetors (on the well-known gas machine order)	14
Carbureting lamps (like the albo-carbon order)	4
Means for carrying off escaping gas	1
Charging machine (for retorts)	1
Means for cleaning gas (service) pipes	1
To detect leaks in gas mains	1
System of gas distribution	1
Gas drip boxes or traps	2
Gas main	1
Guide-wheel carriage	1
Gas retort furnaces	4
Hydraulic main	1
Retort door	1
Retort bench	1
Scrubbers and washers	5

Besides these, there were patented one gas engine and a number of devices for lighting and extinguishing gas burners by means of electricity.

The following are the names, numbers, and dates of the patents above classified, copies of any one of which can be had by sending 25 cents to the Commissioner of Patents, Washington, D. C.

No. of Patent.	Date of Issue.	Name of Patentee.	Subject of (named in) Patent.
	1887.		
375,055	Dec. 20..	C. B. Dudley.....	Carburetor.
375,085	" 20..	G. A. McIlhenny.....	*Gas retort furnace.
	1888.		
376,248	Jan. 10..	F. J. Lothammer.....	Carburetor.
376,531	" 17..	A. Lenz.....	Retort charging machine.
376,835	" 24..	S. T. Wellman and G. W. Goetz.....	*Apparatus for the manufacture of gas.
376,836	" 24..		
376,944	" 24..	W. W. Dashiell.....	Ditto.
377,564	Feb. 7..	F. C. Kniese.....	*Process of manufacturing water gas.
377,607	" 7..	M. A. Foster.....	Carburetor.
377,694	" 7..	T. B. Stillman.....	Apparatus for the manufacture of gas.
377,695	" 7..	" "	Ditto.
377,735	" 14..	R. M. Biddleman....	Process of carbureting air.
377,793	" 14..	A. Meyer.....	Gas generator.
378,095	" 21..	A. C. Humphreys.....	Apparatus for the manufacture of gas.
378,283	" 21..	S. R. Brick.....	Means for detecting leakage from gas mains.
378,418	" 28..	J. H. Amiso.....	Gas enriching apparatus.
378,490	" 28..	R. Boecklen.....	*Process of manufacturing water gas.
378,544	" 28..	J. W. Ells.....	Process of carrying off escaping gas from mains.
378,647	" 28..	O. W. Bennett.....	Carbureting lamp.
378,940	Mar. 6..	E. H. Shaw.....	Apparatus for manufacturing gaseous fuel or illuminating gas.
379,769	" 20..	B. S. Dunn.....	Gas and air commingler.
380,040	" 27..	A. Klonne.....	Gas washer.
380,860	Apr. 10..	G. A. Chambers.....	Water trap for gas mains.
380,910	" 10..	T. McGee.....	Apparatus for cleaning charged gas pipes.
380,911	" 10..	G. A. McIlhenny and T. G. Lansden.....	*Hydraulic main for gas works.
381,619	" 29..	E. J. Frost.....	Device for regulating the quantity of carbureted vapor or gas.
381,934	May 1..	A. Kitson.....	Carbureting gas lamp.
382,076	" 1..	E. B. Denny.....	Device for mixing gas and air.
382,371	" 8..	A. G. Meeze.....	Apparatus for the manufacture of gas.
382,372	" 8..	" "	Process for the manufac ture of gas from oil and steam.
382,373	" 8..	" "	Process of making coal gas
382,374	" 8..	" "	Process of manufact'g gas.
382,375	" 8..	" "	Apparatus for the manufacture of gas.
382,585	" 8..	C. Benz.....	Carburetor.
382,819	" 15..	L. Marks.....	Ditto.
383,204	" 22..	J. T. Wilson.....	Ditto.
383,634	" 29..	J. H. R. Dinsmore....	Process of manufacturing illuminating gas from coal.
383,635	" 29..	" "	Apparatus for washing and purifying coal gas.
385,121	June 26..	C. T. King and E. G. Brown.....	Carburetor.
385,378	July 3..	J. F. Shay.....	Device for removing water from gas and other pipes.
385,485	" 3..	J. Stubbers.....	Carburetor.
385,673	" 3..	A. Kitson.....	Carbureting gas lamp.
385,854	" 10..	D. D. Flemming.....	*Retort gas furnace.
385,873	" 10..	T. F. Marvin and W. F. Cosgrove.....	Apparatus for mixing aeriform fluids.
386,364	" 17..	C. Stillwell.....	Apparatus for the manufacture of vaporous and gaseous fuel.
386,410	" 17..	G. F. Mayer.....	*Gasholder guide-wheel carriage.
386,458	" 24..	V. L. Elbert.....	Apparatus for the manufacture of gas.
387,676	Aug. 14..	G. S. Dwight.....	Process of manufacturing gas.
388,163	Aug. 21..	Geo. Westinghouse, Jr.	System of gas distribution.
388,465	" 28..	A. Thompson.....	Apparatus for the manufacture of gaseous fuel.
388,474	" 28..	F. Bredel.....	Gas condenser and tar separator.
388,849	Sept. 4..	G. S. Dwight.....	Apparatus for manufacturing water gas.
388,903	" 4..	W. Morava.....	*Gas scrubber.
388,953	" 4..	A. Coze.....	Gas retort bench.
389,103	" 4..	H. C. Rew.....	Apparatus for manufacturing gas.
389,104	" 4..	" "	*Apparatus for the manufacture of gas.
389,105	" 4..	" "	Ditto.
389,106	" 4..	" "	Process of making gas.
389,567	" 18..	F. G. Hall.....	Apparatus for the manufacture of gas.
389,575	" 18..	W. R. Jones.....	Furnace.
389,785	" 18..	J. F. Allen.....	Gas scrubber.
390,037	" 25..	F. Rucke & W. Wolters	Carburetor.
391,386	Oct. 16..	J. M. Rose.....	Process of manufacturing water gas.
391,387	" 16..	" "	Apparatus for the manufacture of water gas.
392,202	Nov. 6..	R. Harberthur and R. Brenner.....	Retort door.
392,406	" 6..	H. C. Campbell.....	Gas main.
392,458	" 6..	H. M. Pierson.....	*Manufacture of gas.
392,553	" 6..	M. Gross.....	Apparatus for manufacturing gas.
392,554	" 6..	" "	Ditto.
392,555	" 6..	" "	Ditto.
392,897	" 13..	O. B. Weber.....	*Regenerative gas furnace

Such of these as are marked with an asterisk will be illustrated, along with, perhaps, for comparison's sake, illustrations of other patents.

Before proceeding further with this review, it may not be out of place to point out how very difficult it is to invent anything really new in gas processes, or even apparatus, by calling attention to a few examples of old inventions, picked out at random from a large number of foreign patents well-known to the writer.

For instance, on May 15, 1824, John Holt Ibbetson was granted a patent for an improved apparatus for gas making (and process as well), in which he describes a furnace very much like our present water gas generators. In this furnace he has the air draught go *down* from the top of the coal in said furnace, through the coal and the grate, and then blows steam *up* through the same.

In 1845 Wm. Radley patented a grate for a gas generating furnace, made of fire clay. Peter Armand Le Compte De Fontain Moreau invented a regular fuel gas producer, and patented same, Sept. 7, 1852. This producer was in form, and was operated, exactly like one reinvented, and successfully operated for some time, by the writer, at St. Louis, Mo. (and patented by him in 1885), with only this difference—and it happens to be a material difference, too—viz., mine had an exhauster in place of the Compte's chimney to take away the gases made in the furnace, and to cause a necessary in-draught of air to support combustion at the same time. This latter feature of the device is also shown, though not claimed, in patent No. 389,103, granted to H. C. Rew on Sept. 4, 1888.

That feature in a producer is of more value than a casual observer might think; and it may be here remarked that if any existing gas company would like to own the patent right to use that particular patent, they can have it—if not already sold (as it is in some territory)—by simply paying the registry fee to the U. S. Patent Office, and a nominal sum—say one cent—to the writer.

(To be continued.)

Artificial Stones.

The London *Builder*, in the course of a very interesting article on this subject, prints the following in respect to that section of the article which deals with "Asphaltic and Tar-containing Stones:"

This division of our subject embraces those stones or compositions in which asphalt, bitumen, pitch, or tar form prominent ingredients, and includes a few patents of interest. Asphalt itself has been known from very early times, and is referred to as bitumen, mineral, or Jew's pitch by ancient writers. It is supposed to have constituted the "slime" employed instead of mortar in the building of the Tower of Babel, and also

to have been used for waterproofing the ark of bulrushes in which the infant Moses was placed.

The substance is found in various parts of the East, in Trinidad, Peru, California, and in Europe, where the chief deposits now worked are those of Seyssell, near the Rhone, where about 1,500 tons are obtained annually, and of the Val de Travers, in the Canton of Neufchatel, Switzerland. Asphalt is of complex construction, and evidently a product of the decomposition of vegetable matter; its melting point is about that of boiling water, and when cold it forms a smooth, hard, somewhat brittle surface. Much of the so-called asphalt used for paving streets, bridges, covering roofs, waterproofing tanks, etc., is not the natural product, but an artificial one composed of asphalt mixed with pitch or gravel or finely-powdered bituminous limestone, such as that found near the Jura Mountains. This "asphaltic mastic," as it is called, laid down hot, becomes firm and hard on cooling.

"Lyons Asphaltum" is composed of asphalt 15 parts by weight, coal cinders 35 parts, powdered coke 10 parts, lime 130 parts, and fine gravel 160 parts. The asphalt and coal cinders are mixed in a boiler, heated, and skimmed until the formation of froth has ceased; the powdered coke and lime are then intimately mixed and heated to 575° F., and when quite dry incorporated with the ingredients in the boiler, after which the gravel is added.

The earliest patented application of asphalt is that of Admiral the Earl of Dundonald, who, in 1851, patented the employment of Trinidad asphalt and mineral bitumen of the North American Colonies in the production of artificial stones and other useful objects.

Pym's composition, patented in 1855, was composed of 5 cwt. of asphalt, 5 cwt. of chalk or limestone, 1 lb. of sal ammoniac, and as much sand and grit as will mix freely with the above ingredients when heated in a cauldron; the heated mixture is then cast into the desired forms, and if extra toughness is required cocoanut fiber, shavings, or other fibrous materials must be well incorporated.

In Rowcliffe's patent (1855, pat. 2,906) the asphalt is reduced to small particles, and compressed by hydraulic or other pressure into the desired shapes. Sand or powdered stone may, if necessary, be added to it before compression. Sheil's stone, patented in 1867, consisted of small stones cemented together with asphalt.

A portion of Fear's specification (1868, pat. 2,759), part of which has been already dealt with, relates to a combination of the oxides of iron and asphalt with lime or cement and sand, with or without gypsum, gravel, etc.

R. Skinner's patent asphalt blocks are prepared as follows: 800 lbs. of asphalt are placed in an oven and submitted to sufficient heat to drive off water and easily volatilized matters. In a short time the material is capable of being easily powdered, and in this state it is introduced into a large revolving cylinder heated up to 200° F., and then are added 300 lbs. each of pulverized slag, coke, and limestone, and about 20 gallons of mineral tar. The tar should be previously boiled to expel water, and thoroughly mixed with the limestone before being added to the other ingredients. After mixing and heating, the product is conducted from the revolving cylinder to a revolving pan, and the temperature lowered to 150° F.; in this state it is placed in moulds and subjected to heavy pressure.

Tucker, an American patentee, also compresses mixtures of slag and asphalt into blocks.

Fottrel's patent (1873, pat. 3,086) prepares an artificial stone especially adapted for making drains, pipes, etc., by boiling together a mixture of 13 cwt. of finely-powdered stone, 4 gallons of shale oil, 2 cwt of Trinidad asphalt, and 2 cwt. of bituminous rock. When thoroughly mixed the composition is run into suitable moulds.

Some authorities state that it is far better not to melt asphalt with heat, but to use solvents such as carbon bisulphide, naphtha, or benzine. These substances evaporate readily, and leave a fine, hard coating or varnish of asphalt; but it must be borne in mind that the use of such extremely volatile and inflammable solvents involves considerable risk.

Keltman, in his improved process (1884, pat. 12,425), produces a more homogeneous material than is usually obtained. He proceeds as follows: Crude asphalt is heated with hydrocarbon oils, and impurities are got rid of by deposition; the quantity of oil used is such that, at a temperature of from 17° C. to 33° C., the bitumen should be capable of being drawn into threads; limestone, ordinary or bituminous, is powdered and mixed with about 40 per cent. of water, forming a thin cream; 15 per cent. of the asphalt or bitumen, at a temperature of 70° C., is then added, and the whole well incorporated; finally, the temperature is raised to expel the water, and the liquid mass is cast into blocks, which when cooled are ready for use.

Tar and pitch paving and stone-making compounds are often confounded with those made with asphalt, though in reality they are a totally distinct and inferior class. The following mixtures have been patented: Gas tar mixed with mud or slime from the bottom of rivers, canals, etc., finely-divided peat, and a little dry sand or gravel formed a compound patented in 1843 by C. Bertram, of Newcastle on-Tyne. Williams, in 1851, proposed the use of a mixture of rosin, pitch, and sulphur melted together, to which was then added gypsum, lime, sharp sand, gravel, breeze, broken brick, stone, or other hard material, and a little dead oil.

W. Hutchinson patented, in 1855, a dark artificial stone made by boiling coal tar until all the water is driven off, and then adding perfectly dried waste pieces of stone, chalk, or gypsum; the boiling is maintained for some time until the materials are completely saturated, when they are withdrawn, crushed to powder, and compressed into moulds of desired shape when still hot. A lighter colored stone can be obtained by substituting rosin for tar. Stones produced in this way are said to be impervious to moisture and vermin, and very hard.

Provisional protection only was granted in 1861 for a mixture of pitch, lime, and gravel. McDonell's improved concrete, patented in 1868, was a combination of ground stone, chalk, lime, grit, shingle, broken stones of all sizes and descriptions, with pitch or tar and ground burnt clay.

The Rev. G. H. Forbes, in 1873, prepared a cement for making artificial stones which may be included here, though the finished product is free from tar, being formed by burning together a mixture of tar, pitch, or bitumen with Portland, Roman, or other cement. After grinding, the cement is mixed with water and moulded as required.

A bituminous mortar, or stone-forming material, used in America, especially in the petroleum districts, is made by utilizing a kind of pitch, or bitumen, obtained as a bye-product in the manufacture of paraffine oil; this is mixed, in a melted state, with a powder composed of one part good slaked lime, and two parts sharp quartz sand.

W. E. Constable's "London Artificial Asphalt" (1886, pat. 3,832) is formed by crushing hard limestone, and heating to about 130° F. to remove moisture; to every ton of this dried material is then added about 12 gallons of distilled tar (free from oil, creosote, and water), and the resulting mixture is stored for at least three months; to this preparation, as a base, lime, sulphuric acid, and bitumen are added to complete the formation of the artificial asphalt.

The Guide-Framing of Gasholders: How, and How Far, May It be Dispensed With?

[A paper read by Mr. George Livesey at the November Meeting of the Southern District Association of Gas Engineers and Managers. Reprinted from the London *Journal*.]

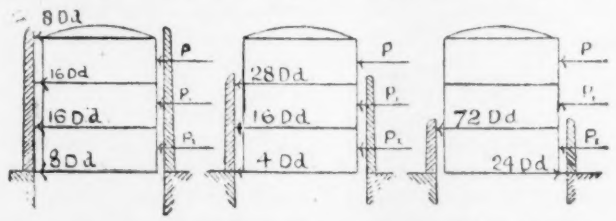
The question has two aspects—the first is a scientific, and the second is an economical problem. Supposing the first to be settled satisfactorily in the affirmative—that guide-framing can be abolished partially or entirely—the theory is not likely to be adopted in practice unless a considerable saving can be effected.

It has been proved, both theoretically and practically, that the guide-framing of telescopic holders can be safely reduced in height without appreciably increasing the strength of the holder or the remaining guide-framing. The theory is to be found in the series of able and exhaustive articles, by "Theory and Practice," that have appeared in the *Journal of Gas Lighting* (which I hope will be published separately); and the practice is to be seen at Rotherhithe. So far as the Rotherhithe holder is concerned, the idea originated in 1881, as may be seen by referring to the *Journal* for December 27, 1881, where, in a letter referring to the large holder then just completed at the Old Kent Road, I said:

"I close this letter with an idea that has occurred to me this week, and which may some day be carried out in practice. I believe it would be quite practicable and perfectly safe to erect and work such a gasholder as this with three lifts of 53 feet each, if the guide-framing reached only enough for one lift—say 55 feet [of this I am now doubtful] in order to guide the inner holder until the second is cupped. The process would then be repeated; the second lift being guided and kept in its place until it lifted the third, which would rise to its full height and be held firmly in position by the combined radial and tangential rollers on the grip of the outside or bottom lift with similar rollers on its curb working against guides in the tank."

The principle was tested soon after by telescoping a small holder about 8 feet diameter by 8 feet high—the inner lift having no guide-framing; and the experiment being successful, the large holder at East Green-

wich, just completed, would have been built with a shortened framing had we not been advised that the stresses on the unsupported part of the holder would be of such an entirely novel and serious nature that it would not be safe to try an experiment of this kind on so large and exposed a structure. The first attempt in this direction was, therefore, made in 1887 (but designed in 1886) on a more modest scale at Rotherhithe, where an ordinary double-lift gasholder, erected in 1867, 150 feet diameter by 25 feet deep, with 16 cast iron columns 50 feet high, and two tiers of girders, has been converted into a three-lift holder without increasing the height of the original framing, or strengthening it beyond what would have been necessary had it been carried up the extra height. The strengthening consists simply of diagonal bracing; and the only additional expense was replacing the channel-iron guides with H-iron to furnish paths for the combined radial and tangential rollers on the grips of the middle and outer lifts. These tangential rollers are the only addition to the holder necessitated by the shortened framing. The experiment, therefore, proves that a double-lift holder can thus be safely converted into three lifts with advantage on the score of economy, which is its justification; but it is very doubtful whether the ordinary framing can be further reduced without adding so much to the strength of both framing and holder as to prevent any further saving.



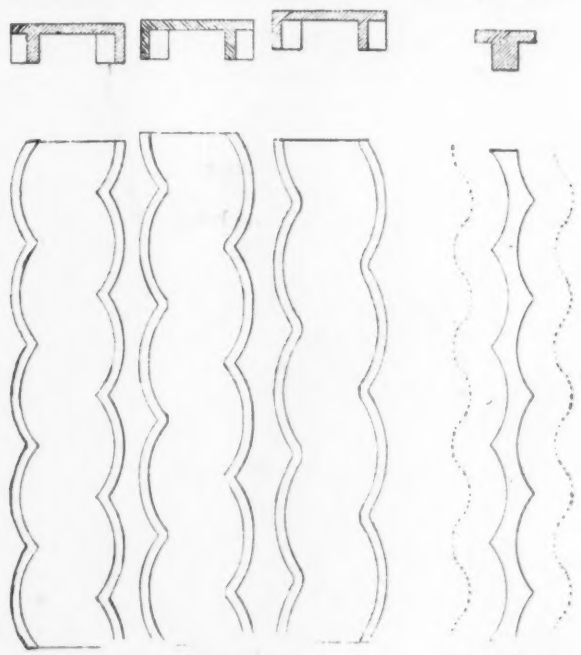
In the first place, according to the accompanying diagram (copied from an article by "Theory and Practice" in the *Journal* of Sept. 25 last, p. 547), in a three-lift holder with framing two lifts high, the stresses on the framing are not appreciably increased; but with framing only one lift high, they become very seriously augmented—necessitating great additional strength. Secondly, there are the stresses on the bell, which are dealt with in the article on page 963 of the *Journal* of Nov. 29, 1887, where it is said that "gasholders can be constructed safely with the inner lift unsupported by external guide-framing after it has cupped, providing the guide-framing is carried to the height of the two outer lifts." But the writer, dealing with "three-lift holders one lift supported by guide-framing," says (speaking of the side sheeting acting as the web plate of a girder) the diagonal strains tending to distort and buckle the sheeting would be so great that he comes to the conclusion "that it is not safe nor advisable to make treble-lift gasholders with guide-framing to the outer lift only." These conclusions are repeated in his article on page 677 of the *Journal* for Oct. 16 last; and until these conclusions are proved to be erroneous, he would be a bold if not a rash man who ventures lightly to construct a three-lift holder with *ordinary* guide-framing to the height of one lift only.

But "Theory and Practice," at the close of the last article above mentioned, has a "Note on Mr. Gadd's Gasholder," which shows that, by a different form of guiding, the method of determining the strains must be different; and this points to the possibility of further reducing or abolishing the framing, and brings us back to the article in the *Journal* for March 29, 1887, and to Mr. Webber's paper of last year—to whom undoubtedly belongs the credit of the really original idea of constructing and working gasholders without external framing. Until he suggested the idea it had never, so far as I know, been even thought of; and if gasholders should ever be so constructed, the merit of the suggestion rests with Mr. Webber. After this, it occurred to me that if some means could be devised whereby the bottom curve, while free to rise and fall, could be maintained perfectly level, a great step would be made in the direction indicated by Mr. Webber. I said in the *Journal* for April 26, 1887, "if some *practicable* means could be devised whereby all the bottom rollers might be made to rise or fall equally, and none of them could either rise above or fall below the others, the holder would then to all intents and purposes have a solid foundation, and no columns or guide-framing of any kind would be necessary." Thus a holder rigidly level would be secured, and at the same time it would be free to move up or down with the inflow or exit of gas. For some time, however, the accomplishment of this object appeared impracticable; but Mr. Gadd's ingenious and novel invention of spiral guides seems to have solved the problem.

The important question now is whether, by Mr. Gadd's or any other plan, it is advisable or practicable to dispense entirely with guide-framing for telescopic holders, having regard to the want of strength in the side sheets to resist the distorting and buckling strains in an unsupported holder. By Mr. Gadd's invention we are enabled for the first time to hold the bottom of a holder in a horizontal position. It is not like a cylinder simply standing on a solid foundation; but is a cylinder (closed at the top) supported from the crown with the sides suspended therefrom, and the whole held firmly level by the rollers acting on the spiral guides. But I cannot see that this diminishes the distorting and buckling strains on the side sheeting of an unsupported holder. If, however, these strains can be proved to be of no great moment, then Mr. Gadd will have shown how Mr. Webber's idea of no framing can be made practicable.

Assuming that for single holders, or shallow telescopic ones, unsupported by guide-framing, the idea of holding the bottom curb to be successful, we have in the next place to find the simplest plan of effecting that object. We have Mr. Gadd's clever application of the screw or inclined guides; and I have now to introduce an upright guide to effect the same purpose. It is either made in channel form with a single tangential roller, or solid with a tangential roller working on each side. In the case of the channel guide, the roller must be carried on a stud unsupported at the outer end; but with the solid guide the rollers work on pins supported at both ends—thus having the advantage of greater strength. The peculiarity of the guide consists, as shown, in alternate projections and hollows on the sides. The projections on one side are opposite to the hollows on the other, against which the roller or rollers work, thus compelling them to take a zig zag course. This produces in the holder in its rising or falling a slight alternating movement on its vertical axis—turning, in fact, like a top on its center, but only to a very small extent in one direction (say) to the right, when the action is reversed and it moves to the same extent to the left; then again to the right, and so on. The projections may vary in size and shape; but here they are shown as equal to one-fourth the diameter of the rollers—say 3-inch projections for 12-inch rollers—and as the zig-zag path is of exactly the same width as the rollers, there is thus 6 inches clear between the projections on the sides of the guides, which may be used as a path for radial rollers if required.

The guides being fixed either to the side of the gasholder or to the tank, in exact correspondence, the closely fitting rollers must of necessity all move together in the same direction, and to the same extent. Consequently tilting is prevented; the bottom curb being held rigidly level,



Channel Guides for One Tangential Roller. Solid Guide for Two Tangential Rollers.

The dotted lines show the paths of the centers of the rollers.

though perfectly free to rise and fall. The overturning force of the wind is resisted in an entirely different manner to that of ordinary framing. The rollers on the lee side hold the curb up, while those on the windward side hold it down; whereas with ordinary framing tilting is resisted by two or more series or circles of rollers at different levels bearing on the guide framing. In one case the base is secured; in the other the sides are supported. The difference, therefore, is radical; and it may bring Mr. Webber's idea within the range of practical engineering. Of course, the effect arrived at with the corrugated guide is the

same as Mr. Gadd's spiral; and it is not my intention to disparage the latter, or to draw comparisons between them. If both accomplish the same object, it remains for impartial practical men to determine which is the more suitable for the purpose; and if any should prefer mine, they will not find that the protection it was necessary to obtain in the form of a patent will prove an obstacle to its adoption.

If either the spiral or corrugated, or both forms of guides prove effective, it will then no doubt be practicable to work single gasholders, or small and shallow telescopic ones of two or possibly three lifts, without guide framing, as holders of this kind are proportionately much stronger than larger vessels—the sheeting being of about the same thickness in both cases. If successful, it will remove the objection to shallow holders; and in fact will make them both economical in construction and safe in working. Expense will be saved in the tank; while the holder of four, five, or possibly more lifts, with the cups at comparatively short distances apart, will be better able to resist the diagonal strains that tend to distort and buckle the sheeting if unsupported by guide-framing. For large and deep holders, the utmost I expect from the new form of guiding is that, by reducing the strains on the guide-framing, it will not be necessary to increase its strength when leaving two lifts out of three or more unsupported. Beyond this, as the new guiding arrangements do not in any way affect or diminish the strains on the side sheeting of the part of the holder which is not supported by framing, the danger of distortion and buckling renders it impracticable to work the three lifts of a large and deep holder guided from the bottom curb only, without greatly increasing the strength of the side sheeting, and so adding to its weight and cost that all advantages would disappear and the balance be on the wrong side. Let us hope that on this point there may possibly be a mistake, and that all the predictions and hopes of the enthusiasts will be satisfactorily developed in practice.

Economy in the Production of Artificial Light.*

By Norton H. Humphrys, Assoc.M.Inst.C.E., F.C.S.

A singular fact connected with all manufacturing operations is that there is a certain amount of waste. In no case can any technical or industrial process be carried on without the production of residues that are practically useless. Large heaps of spoil accumulate at the coal mine, great mountains of slag at the iron works, tremendous mounds of "soda waste" at the soda works; and though modern science has done a great deal in the way of turning many of these residues to account, still there always remains something or other that either has to be carted away outside the town or allowed to flow down the sewers.

This leads to a second consideration, and that is the fact that although many of these residuals could be turned to account, the cost of doing so would not be remunerative. They resemble white elephants, and it is wiser in a financial sense to throw them away than to try to realize the valuable commodities that, regarded from a purely theoretical point of view, they undoubtedly contain or are capable of yielding. An instance of this comes home to us in the case of coal tar, which is known to contain valuable dyes, essences, and other substances that are literally worth their weight in gold, for when obtained in the pure form they are worth £4 or £5 per ounce. But yet within the last year or two large quantities of tar have been burnt as fuel, and, as the theorist would say, the valuable substances have been wantonly destroyed. The reason is simply that the expenses of "working up" the tar for the recovery of the residuals—including carriage of tar, merchants' and dealers' profits, and all other charges—would be greater than the value of the product obtained. To realize the value of £5 we should have to spend perhaps £6, and therefore the profit which appears tangible in theory becomes converted into a minus quantity in practice. Many enthusiastic inventors and originators of new processes know this to their cost.

So far we have been considering the production of physical substances only—the dealing with solids, liquids and gases. But within the present century commercial enterprise has gone beyond the limits of matter and undertaken the manipulation of forces, by the sale and distribution of light, heat, cold, electricity, and mechanical power. The forces are so intimately connected one with another that we cannot produce one of them by itself. We want heat only, but all our known sources of heat also produce a certain amount of light and electricity. We want light only, but we cannot produce it by itself. It is always accompanied with radiant and connected heat and with electricity. It is possible to isolate most of the material elements, to separate them from all others, and obtain them in the pure form. But we know of no analogous means of dealing with forces. So the considerations above named apply even more stringently to the commercial production of forces, and none the less so because the "waste heaps" are not tangible to our senses, being silently and invisibly dissipated as fast as they are formed.

Take the case of the electric light, the object of which is to produce light rays at the point of the carbon or in the vacuum bulb. What a waste of force takes place! Heat is produced, as a commencement, by the combustion of fuel, and a large quantity of this is at once disposed of by escaping up the chimney with the products of combustion, besides that lost by radiation, conduction, etc. Then a considerable quantity of heat is rendered latent in evaporating the water to produce steam, since about four times as much heat is required to convert any given quantity of water into steam as will suffice to raise it to boiling point. In connection with the engine there is a loss of useful effect due to friction, etc., and in the dynamo machine there is also a loss due to cross currents and other obscure phenomena.

When the electricity is generated it cannot be distributed to the lamps without a substantial loss in the way of leakage, etc. And, lastly, in the lamp itself there is waste, due to the production of heat and actinism, in addition to light. In a similar manner we might take the production of coal gas, and point out the various sources of waste that are inevitable from the production of light by that medium; or to take a simpler illustration, it could readily be shown that when a candle or a lamp is used as a source of light, by far the greater portion of the energy produced is dissipated in the form of heat, and a very small proportion only is secured in the form desired—that of light.

The foregoing considerations are suggested by the perusal of a most interesting lecture on "Photometric Standards," delivered at a recent meeting of the Western Gas Association (U.S.A.), by Prof. Mendenhall, of the Rose Polytechnic Institute, Terre Haute, Ind., and published at length in the American Gas Light Journal, for June 16th last. After describing and remarking upon the photometric standards at present known, the Professor goes on to speak of the energy developed by various illuminants, by which term he means the quantity of work, the foot pounds of work, that would be available if all the heat produced could be converted into work. The heat produced can be readily estimated or calculated, and then it is converted into terms of work by Joule's equivalent, viz.: 772-foot lbs. = one B.A. unit of heat. Putting the results in a tabular form they are as follows:

One stearine candle.....	= 0.114 H.P.
One spermaceti candle.....	= 0.111 "
Gas burner—5 c. f. per hour.....	= 1.2 "
Incandescent electric lamp (15 candle)	= 0.1 "
Arc electric lamp (1,000-1,500 c'ndl's)	= 1.0 "

This calculation, of course, deals with the lamps exclusively, and does not consider the waste that may be necessary in producing and supplying the medium by which they act. Nor does it prove anything as to the relative economy of the various lights, seeing that the cost of energy varies greatly according to the circumstances under which it is produced. As an illustration of this point the Professor remarked that the energy expended in the electric telegraph costs about £2,000 per h. p. He went on to direct attention to the question of how much force, how much horse power, is really necessary to produce the phenomena of vision. Quoting some experiments carried out by Professor Langley, he showed that only an infinitesimal expenditure of power was really sufficient to produce light. Professor Langley had succeeded in producing the effect of vision, including all the colors of the spectrum, by the expenditure of only one 300-millionth part of a horse power, and also proved that one-millionth part of this very small fraction would be sufficient. Going further than this, it was shown that there were particular parts of the spectrum where light was most effective. A point between the yellow and the green in the normal solar spectrum, is most effective, and energy put into light of that wave length (that is, color) would produce more than one million times the effect on the eye, than if at the red end or in the violet. The problem is to produce only those vibrations that are useful as light, to the exclusion of all others.

Mr. W. H. Preece, whose enthusiasm on all matters pertaining to electricity is only equaled by his prejudice against its rivals, in a recent discussion at the Institute of Civil Engineers, made one of his usual speeches, in the course of which he showed that if coal gas was used as a source of power by the medium of a gas engine, and that power was applied to the generation of electricity for the supply of electric lamps, a light giving effect equivalent to 15,000 candles would be obtained if incandescent lamps were used, or of 90,000 candles with arc lights, for each 1,000 cubic feet of gas used. But if the same quantity of gas was burnt directly, he stated that the light equivalent would be 3,000 candles. Now, by means of improved burners, a duty approaching ten candles per cubic

*Gas Engineer's Magazine,

foot can be obtained, so that instead of 3,000, it would be nearer the truth to say 8,000 or 10,000 candles. The same gentleman, in the course of an address at Bath, gave the following estimate :

One candle light maintained by	tallow	absorbs	0.166	H.P.
"	"	"	wax	"	0.126	"
"	"	"	sperm	"	0.115	"
"	"	"	mineral oils	"	0.107	"
"	"	"	vegetable oils	"	0.076	"
"	"	"	coal gas	"	0.091	"
"	"	"	cannel gas	"	0.064	"
"	"	"	electricity (arc)	"	0.004	"
"	"	"	electricity (glow)	"	0.074	"

We have the fact that in order to produce an infinitesimal quantity of a particular kind of force, we use up a very substantial quantity. In order to get an effect that might be afforded by the expenditure of less than one billionth of a horse power, we use up various quantities ranging from one-sixth to $\frac{1}{25}$ h. p., according to the kind of medium adopted. In order to form a clear idea as to the nature of this waste, it is necessary to touch upon the modern theory relating to the various kinds of forces. To explain this fully would require much more space than is at present available, so it will be sufficient to mention the generally accepted idea among scientists, that all forms of force are simply forms of motion. For want of a better term this motion is usually termed vibration, and it need not necessarily be plain swinging backward and forward like the motion of a pendulum, but may be circular or in any kind of curvular path. The vibration is simply a rapid repetition of the same round or course of motion.

Let us suppose a rod of iron to be connected with machinery by which it can be made to oscillate or vibrate with a gradually accelerated speed, commencing at one readily perceivable to the eye and increasing up to inconceivable rapid rates. At first no effect would be observable except that the eye soon failed to follow the vibrations. At a velocity of about 8 double or 16 single vibrations per second a sound or audible note of very low pitch would be heard. As the rate of vibration increased, the pitch of the note would rise, gradually passing through the bass and treble, until the highest audible note was reached. After this no sound would be heard, but after a time an appreciable amount of heat would be produced ; this would gradually rise up the thermometric scale, just as the pitch of the musical note rose, until a dull "red heat" became visible. This forms the commencement of the light rays, and these gradually range through red, orange, yellow, white, to blue and violet. They follow a regular order of progression, as in the case of light and heat, and it has been proved that while sound extends through about 8 octaves, heat rays range through 2¼ octaves, and light rays through 1 octave. These light vibrations are extremely rapid. Professor Oliver J. Lodge states that the vibrations effecting the retina range between 4,000 and 7,000 billion per second. There are vibrations even more rapid than those which produce the effect of light, such as those which produce chemical effects, and are useful in the art of photography.

The reason why there is so much waste in the production of artificial light is rendered evident by the above illustration, which, however, is of a very crude and imperfect character. It is suitable for our present purpose, but must not be taken as an accurate indication of the various phenomena of sound, light and heat. In order to produce the effect of light a very small extent of matter, merely a few atoms, made to vibrate at a range intermediate between the limits above named, is all that is needed. Indeed it appears, according to Professor Mendenhall, that there is one particular limit, somewhere between 5,000 and 5,500 billion vibrations per second, when the greatest activity in light giving power per unit of matter is realized. In order to produce just the sort of vibrations we require, however, we know of no better method than to produce a heterogeneous mass of all kinds. Some of them are too slow, and result in the production of heat ; others are too rapid, and yield the chemical effects known as actinism. To quote Professor Lodge again : "The process is evidently wasteful, indirect and empiric. We want a small range of rapid vibrations, and we know no better plan than to make the whole series leading up to them. It is as though, in order to sound some little shrill octave of pipes in an organ, we were obliged to depress every key and every pedal, and to blow a young hurricane."

The question is, how to produce light only, without the accompaniment of heat, actinism or other forms of energy. The mind naturally turns to the phenomena known as phosphorescence, as exhibited in certain insects and animalculæ, and also by certain chemicals, notably the sulphide of calcium, as an illustration of the production of pure light. Attempts have been made to render this method of producing light applicable in practice, but as yet the only result obtained is that of the kind popularly known as "darkness visible." Certain bodies are known to possess the property of retaining the power of emitting light for some hours after being exposed to a powerful light source, as though they absorbed a certain amount of light rapidly and gradually diffused it ; just as a delicately-poised vane rotates for several minutes after receiving an impulse.

We have seen that all known methods of producing artificial light are wasteful to such a vast extent as to cause the differences between them, one to another, to sink into utter significance. It is therefore useless to talk of "the light of the future," as, with such a vast margin for improvement, there is no possibility of foreshadowing the course that lines of advancement may take. Even such a small amount of force as that indicated by the expression "one-horse power" would suffice, if properly applied, to illuminate a large town for several nights. So that, if ever "the light of the future," by which term I understand something that cannot be improved upon, is realized in practice, its cost will be absurdly cheap according to our present notions. Meanwhile the facts to which attention has been directed in this paper are most encouraging to inventors. If we cannot at one jump reach the far distant goal, there is no reason why an approach to it much nearer than anything at present known should not be attained ; or why, even with the defective methods at present at disposal, the vast proportion between "useful" and "wasteful" effect in connection with the production of artificial light, should not be substantially decreased.

A Special Air Supply for Gas Burners.

[Communicated to the London *Journal* by Norton H. Humphreys, Assoc. M. Inst. C.E., F.C.S.]

To those who, from force of circumstances, have been obliged to contemplate the subject of gas consumption from a theoretical point of view only, or from an outside position in a practical sense, the new system described in the *Journal* for the 16th ult. (p. 672), under the head of "A New Combined System of Gas Lighting and Ventilation," is of marked interest. It represents a bold attempt to gather and consolidate into practical shape a number of vague, hazy, and indistinct notions that have been floating about in the brains of most gas engineers who have taken an interest in the scientific and theoretical department of gas manufacture and supply, and which perhaps date back almost from the commencement of the gas industry. The effect of diluents such as carbonic acid, air, nitrogen, and aqueous vapor on the illuminating value of coal gas has been several times ascertained by experiment. Incidentally, the effect of the air used for the supply of a gas flame has been noticed, though it does not appear to have occurred to anyone to make experiments in the way of a special air supply. For example, when writing on the subject of "The Commercial Valuation of Coal Gas," about four years since, I remarked :

"We know that if gas is burnt under a low atmospheric pressure, such as that furnished by the attenuated air on the top of a mountain, or in an atmosphere rendered poor in oxygen by the presence of other substances, the amount of light given by the flame is much reduced, though at the same time the flame is increased in size. Its intensity is diminished ; but its quantity is increased. The presence of diluents in the gas itself has the same effect, of impoverishing the atmosphere in which the combustion is taking place. The result is that the gas is burnt at a disadvantage, and does not yield the amount of light it would be capable of giving under more favorable circumstances. * * * The purer the atmosphere, the less concentrated the flame ; and as the flame becomes less concentrated, it gets yellowish in color and dull in appearance."

Many similar remarks might be quoted from articles or lectures on the subject of gas consumption ; but, with the exception of the practice of supplying air under pressure to burners of the incandescent class, the writer is not aware that any proposal in the way of a special air supply has ever been made. In the case of the incandescent burners, the object is to promote combustion ; so that the idea of giving a separate and purified air supply, with the object of increasing the duty per cubic foot of gas consumed, is probably entirely novel.

Yet every gas engineer must have noticed at times the important effect exercised by the condition of the atmosphere upon the value of his gas. It is a matter of common remark that the street lamps burn much brighter on a clear, dry, and frosty night than when the weather is heavy, damp, and muggy. Various opinions have been expressed as to the cause of this. Barometric conditions have undoubtedly some effect, for it has been shown in several ways, since Professor Tyndall burnt a candle on the top of Mount Blanc, and noticed that it gave very much less light than when used in the valley below, that any illuminant is affected by variations in atmospheric pressure. By reducing the pressure the luminosity can be destroyed ; and, on the other hand, sub-

stances which yield a practically non-luminous flame at ordinary pressure—marsh gas, for instance—give a considerable amount of light when consumed in an atmosphere that has been artificially placed under a pressure of 60 or 70 pounds per square inch. This being the case, it follows that a barometric variation between 28 and 31 inches, or to the extent of 10 per cent., in the pressure of the atmosphere, will have a notable effect upon the illuminating value of ordinary coal gas. Some experiments on the point would be extremely interesting.

In the suggestion that the moisture which is always present in the atmosphere to a greater or less degree—and in England the "greater" usually obtains—has an important effect on the illuminating value, we have a new line of thought opened up. Speaking generally, the lower the barometer, the greater the proportion of moisture in the air; so much so that the indications of this instrument are regarded as a weather guide—a "fall" indicating wet, and a "rise" fine weather. So it would appear that, at low pressures, the gas has not only to contend with the disadvantages due to an attenuated atmosphere, but also with those caused by the presence of a larger quantity of moisture in the air than usual.

In contemplating the subject of gas combustion for lighting purposes, and the use of fuel gases as a source of heat for high temperatures, as in retort settings on the generator system, a remarkable coincidence will be observed. It is a usual experience that the best lighting effect is obtained from a gas burner just as the gas is on the point of smoking. This means, when it has a sufficient supply of air and no more. The upward draught created by the products of combustion and by the escape of the gas from a burner, causes a continuous fresh air supply to it, exactly as the draught of the chimney brings the air supply to a furnace. An increased pressure causes an augmented supply of air; and a burner under great pressure of supply may be compared to a generator furnace in which the damper is set too high, so as to draw in an excess of air, or to the old-fashioned grate furnace that will not act satisfactorily unless an excess of air is admitted. In the burner we decrease the supply pressure until something near to the theoretical requirement of air is attained; and in the furnace we adopt other means for securing the same end. The result is that more heat is retained in the gas flame or in the furnace, as shown by the higher temperature obtained, and a proportionately less quantity passes off with the products of combustion. In the gas burner, the greater temperature yields an increase of light; in the furnace it gives us a larger proportion of the total heat in a utilizable form. The analogy also extends to the application of regeneration. The object in each case is to bring back some of the heat that would otherwise be wasted, and to use it as a means of increasing the temperature—the initial temperature, it is usually called.

It is not unreasonable, then, to suggest that the improvements in modern gas burners, by which "the duty" attainable for a given quantity of gas has been increased threefold, or, including the claims advanced for this new system, fourfold, are to a great extent due to the same cause that has led to the improved results from fuels secured by means of the generator system. In each case there has been a better adjustment of the air supply. Whereas it was formerly the rule to work with a considerable excess, this has now been reduced to very little above that shown to be necessary for complete combustion and oxidation of the hydrogen and carbon present in the fuel. When the "special air supply" system has been proved to be a success in respect to an increase of duty from the gas, apart from the other advantages it undoubtedly brings with it, it will be time to consider the application of the same system to the use of fuels on the large scale.

With the ordinary batwing or fishtail burner, used without a globe, there is a free and unimpeded rush of air to the base of the flame on all sides. In Sugg's Argand, and to a greater extent in the various makes of regenerator burners, the air supply is to a certain degree throttled or baffled. In the Argand burner the base of the burner is very much closed in by the cone; and in the regenerator burner the air supply has to take a circuitous course in reaching the burner, while the products of combustion are also "baffled" in passing the arrangement intended to act as the regenerator. It is expressly stated that with the Methven-Sugg system the air supply is arranged to be at the rate of 10 cubic feet per cubic foot of gas. The actual requirement, according to theory, is from 6 to 7 cubic feet; so that an excess of 60 or 70 per cent. is allowed. But this, though apparently high, is a great advance on ordinary burners, all of which require a large excess of air under general circumstances, and probably so with other improved forms of burner; so that, apart from the advantages incidental to the special air supply, some considerable increase of "duty" might be expected from the regulation of the supply.

The statement that an improvement of 10 or 15 per cent. is obtainable by removing the moisture and carbonic acid from the air is striking, but, on consideration, by no means incredible. The effect of the presence of 1 per cent. of carbonic acid in the gas is known to range from 4 per cent. upward, according to the kind of burner used; and there is reason to suppose it to be a constant quantity, irrespective of the quality of the gas, so that the poorer the gas the greater the percentage of depreciation.

As to the effect of moisture, but little is known. Mr. Aitken, in a paper on "The Influence of Aqueous and Other Vapors on Illuminating Gas," read before the West of Scotland Association of Gas Managers in 1878, remarked that the result of drying a sample of gas, by passing it over anhydrous chloride of calcium, was to raise the illuminating value from 27.24 to 27.46 candles—only a gain of 0.8 per cent. At the same time the gas was diminished in volume to the extent of 2.8 per cent. Dr. Percy Frankland states that the effect of drying a sample of gas is to reduce its volume about 2 per cent., and to increase its illuminating value from 16.9 to 17.5 candles. In this case the depreciating effect is about half a candle, or 3.3 per cent. Dr. Frankland obtained a very similar result with ethylene—a rich gas of 70-candle power or thereabouts. He also remarks that some years ago the London Gas Referees found that an advantage of 6 or 8 per cent. was obtained by drying the gas.

The effect of these impurities, when present in the air instead of the gas, will be greatly increased, because ten times as much air is used. Under ordinary circumstances air contains 5 or 6 grains of aqueous vapor per cubic foot. Pure air in the country contains 2 or 3 parts of carbonic acid in 10,000; but in towns this proportion is often more than doubled. The air in the upper portion of inhabited rooms would probably contain a larger quantity both of water and carbonic acid; so that the former may be taken at 7 grains per cubic foot, and the latter at 0.1 per cent. Each cubic foot of gas, therefore, receives at least 70 grains of water vapor and 1 per cent. of carbonic acid from the air; and in the case of ordinary burners a good deal more. This is sufficient to show the importance of extending some consideration to the question of the air supply of gas flames.

Dr. Frankland, in the paper already mentioned, says: "That the presence of aqueous vapor in gas should tend to reduce its illuminating value was to be anticipated, since this aqueous vapor had to be raised to the temperature of the flame by the heat produced in the combustion of the gas. Moreover, the aqueous vapor at the temperature of the flame is partly dissociated, which dissociation is attended with a large absorption of heat; 70 grains is just 100th part of a pound, and the specific heat of water vapor is 0.475. Therefore one unit of heat would be sufficient to raise that quantity of moisture to the extent of 210° in temperature. The flame temperature is very high—perhaps 3,000° F., so that from 12 to 15 units of heat per cubic foot of gas would be absorbed in raising the temperature of the aqueous vapor. A cubic foot of gas yields 6.20 units of heat and upwards, according to quality; so with ordinary 16-candle gas, some 2 per cent. or more of the total heat is absorbed in raising the temperature of the aqueous vapor. This is without allowing anything for dissociation. We have no actual knowledge as to whether or not this occurs to any extent; but it is evident that such an effect, taking place just in the hottest part of the flame, would be greatly prejudicial to its light-giving power. The heat absorbing effect of dissociation would be similar to that involved in raising the temperature of the aqueous vapor another 1,000°, and, if it was complete, would involve the loss of another 5 units of heat. If we calculate the effect of atmospheric moisture as an absorbent of heat from an ordinary furnace, and the enormous volume of air that is continually rushing in to maintain the combustion, it will be seen that, as in the case of the gas flame, the removal of this small and apparently insignificant quantity of moisture is by no means such a whimsical or chimerical idea as it might at first sight appear.

It is a singular fact that the depreciating effect on illuminating value exercised by nitrogen, air and carbonic acid is greater than that of aqueous vapor, although their specific heat is only about one-half. The loss of heat due to the presence of 1 per cent. of any one of these constituents is very slight—not more than 7 or 8 units, or about 1 per cent. of the whole. Yet the loss of light is four or five times as much; and this seems to show that the loss is due to causes other than the mere abstraction of heat.

Messrs. Methven and Sugg are to be congratulated on having obtained, or being within fair prospect of obtaining, such a remarkable duty as that of 13 candles per cubic foot of 16-candle gas— an increase of fourfold on that which was considered to be the limit not very many years ago. Practically the effect is to cheapen gas to a corresponding extent; for if the consumer is enabled to get 13-candle duty out of a gas which formerly yielded only 3.2-candle, the effect is to render it worth four

times as much to him. Mr. W. H. Preece recently estimated (see *ante*, p. 463) that the cost of producing 1,000 candle power—one candle for 1,000 hours—by London gas was 1s. 3d. The means by which he arrived at so high a figure are not at all clear. If we assume gas to be worth only 3 candles per cubic foot, then the cost of the 333 cubic feet of gas required would be less than 1s, With the Methven-Sugg system, however, the cost would be reduced to less than 3d., seeing that about 80 cubic feet of gas would be sufficient. So it is time for electricians to amend their estimates. Another point for congratulation is that the improvement already realized—an increase of fourfold—may well encourage us to be hopeful as regards the future. It has been repeatedly pointed out that only a mere infinitesimal portion of the total force produced by the combustion of gas is really obtained in the form of light, and therefore that there is a large margin to be worked for improvement—so large that the advance already obtained, important as it is in a practical sense, is really of comparative insignificance. But this advancement, such as it is, gives some promise of future progress.

The fact must be faced that a special air supply, and the removal of moisture and carbonic acid therefrom, means extra expense. But the advantages secured are such as to be more than sufficient to compensate for the cost of obtaining them, apart from any consideration as to increased duty from the gas. Rendering the gas combustion absolutely separate and independent from the atmosphere of the apartment at once secures everything in the way of pure air, long life, etc., that has been claimed for electricity, and does away with the prejudice sometimes exhibited in regard to the effect of sulphur compounds, supposed incompletely consumed constituents of coal gas, and the products of combustion generally. It also opens up a means of arriving at what has never been really obtained before—an absolutely reliable system of ventilation that may be equally depended upon under all directions and degrees of force of wind, and other climatic conditions. In this respect it has a distinct advantage over the electric light, which, at the best, is only a "neutral" in the matter of ventilation.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

ONE of the busiest centers in the Lone Star State is the famous old city of San Antonio—better known, perhaps, by Texans as "San Antone." Important railroad extensions, the operation of which has shown to the Northerner, who wishes to bask in perpetual sunshine, the ease with which the many populous centers of Texas can be reached, have worked wonders in developing the natural resources of the State, and now (that the mildness and salubrity of the climate have been attested by those who "were there and experienced its delights and benefits") there is a rush to winter in that section. The good business opportunities afforded by San Antonio, Dallas, Austin, El Paso, Waco, and so on, attract capital, brains and industry to the State; and the returning pleasure seekers fill the ears of their "poor relations" with facts and figures concerning the possibilities of bettering their condition in that member of the United States whose length and breadth can only be summed up in the word magnificent. And it is a fact that the "poor relation" whose present portion is confined to pluck and industry, may there, by well directed effort, soon turn his labor into wealth. It was not our present intention, however, to advertise the merits of the "Lone Star State" in general, but rather to call attention to the inequalities of the lighting systems in San Antonio. The local gas works ought to be a very valuable property, and it is safe to say that an investment of $35,000 would make them so; but the present owners seem indisposed to place the plant in a position where it might become thoroughly efficient. The place boasts of several good hotels (the population of the city cannot be now less than 40,000), notably the Menger Hotel and the Hotel Maverick, and the business houses are of the solid sort. But much complaint is made respecting the lighting service—and it is a fact that if the gas service is not all that it should be, the incandescent electric lighting service is much poorer. We are led to this opinion from a few lines recently received from a correspondent who, during a series of wanderings in Texas, had occasion to remain for some days in San Antonio, his abiding-place having been the Hotel Maverick. Here is what he says respecting the lighting of the hotel: "The gas here is of a low illuminating power, and soon stains the ceilings. We have also the Thomson-Houston system of electricity in use. The candle power of each lamp is supposed to be 16. The light is wretched, and frequently goes out. One night candles had to be distributed about the halls. It (the Thomson-Houston) has just gone out;" and still we are told the light of the future "has come to stay. The lesson is obvious, and so proves that San Antonio's gas men ought to remain masters of the artificial lighting situation there, if they will only employ some of the methods followed by the "poor relation" who visits the Lone Star State for the purpose of bettering his condition.

THE officials of the Concord (N. H.) Gas Light Company, after a thorough inspection of the vessel, have accepted the new gasholder recently completed in the district known as the "South End." The holder is of the single lift order, being 80 feet in diameter and 24 feet in height, the whole being inclosed in a substantial brick building, 86 ft. in diameter by 28 ft. in height, surmounted by a handsome octagonal cupola—the latter can be used as a point for observing the surrounding country by anyone inclined to mount a flight of 88 steps. By-the-way, on the day that the official inspection was made Judge Dana ascended that staircase with as much speed and grace as any other of the inspectors. Messrs. Deily & Fowler, of Philadelphia, furnished and put in place all the iron work, and the excavation was made and the tank and buildings erected by Mr. W. C. Whyte, of this city. Construction work was begun on April 9th, and water was let into the tank on October 13th. The total storage capacity now available is 200,000 cubic feet. In connection with this the sendout figures appended will prove of interest:

Month.	Year and Quantity. 1887.	Year and Quantity 1888.	Net Gain.
July	1,102,000	1,211,000	109,000
August	1,291,000	1,444,000	113,000
September	1,764,000	1,975,000	211,000
October	2,285,000	2,598,000	313,000
November	2,640,000	2,938,000	298,000
Totals	9,082,000	10,126,000	1,044,000

This speaks rather authoritatively for the stability of the gas interests of Concord, and also goes to show that the new holder was not ordered any too soon.

A CORRESPONDENT writes: "The following figures, which explain themselves, show the cost of lighting the City Hall, Boston, Mass. In 1883–4, when the electric light was first tried in the building, the gas used cost $1,888.18, while the electric bills footed up $710.45. Since that time the cost has been:

Year.	Gas.	Electric Light.
1885	$1,684.39	$1,504.00
1886	1,771.52	1,898.00
1887	1,717.50	1,717.46
1888	1,577.68	5,899.29

The great increase in the electric light charge for this year is in some degree attributable to the use of electric lights in the Council chamber—a new departure. Mayor O'Brien is Vice-President of the Company (the Boston Electric Light Company) that performs this work.—HADDAM."

THE proprietors of the Muskegon (Mich.) Gas Company have made a notable reduction in selling rates, the same to take effect from Jan. 1.

AN effort is being made in the Toronto Council to cause the adoption of the following resolution: "That all gas companies, plank or gravel road companies be assessable in respect of all personal property owned by them; also, all pipes and other fixtures, railway tracks, etc., be declared personal property and liable to assessment." Another section of the decree insists that the pipes, poles and apparatus of telegraph, telephone and electric companies placed or erected on the public streets shall be assessable as personal property.

IT is said that the proprietors of the water gas plant now nearing completion in Kenosha, Wis., have agreed to put the initial price of a 22-candle gas at $1.25 per thousand. Perhaps they have figured out where this policy possesses its profit, but we will venture the prediction that the stockholders will never be burdened with excessive dividend checks.

MR. R. B. VAIL has been appointed Secretary of the Rahway (N. J.) Gas Company, vice Mr. Walter B. Houston, whose resignation was reported in our last.

THE Philadelphia *Ledger* reports the following interesting case: "On December 5th ex-Judge Elcock began, in the Court of Common Pleas, a mandamus proceeding on behalf of the Trustees of the Roman Catholic High School against the city and Louis Wagner, the Director of the Department of Public Works. The Trustees in their petition say that, under the direction of the will of Thomas Cahill, deceased, they are engaged in the erection of a school house at the northeast corner of Broad and Vine streets, the site of which was bought from Richard J. Dobbins, in February 1884. They say that they are in need of city gas for the use of the workmen and that, although they are willing to pay the cost

of connecting the meter with the gas main, the Director of the Department of Public Works has refused to put in a meter and the connecting pipes, for the reason that there are several gas bills which were not paid by the tenants of the properties which formerly occupied the present site. One of the gas bills dating back to 1867, amounts to $44.20. The Trustees claim that the city has no lien against the real estate for gas consumed; that the city is only authorized by law to manufacture and supply gas to the public; that gas is a necessity to the general public, and the city cannot refuse to supply it where the owner is in no way indebted for gas previously supplied, nor can the city discriminate between citizens desiring to be supplied with gas. The Trustees, therefore, ask that the defendants be directed to show cause why a meter and connecting pipes should not be introduced," etc. We fail to see how Director Wagner can justify his action in this instance; and we further fail to note how he could successfully defend a damage suit instituted against him by the petitioners, provided they could show a loss accruing as the result of the city's refusal to supply gas light whereby the progress of their building work was impeded. The Director's action might be sanctioned by military practice, but it hardly accords with the softer—though none the less precise—dictum of the civil law.

Mr. George Harper, formerly of Detroit, Mich., has taken service with the Troy (N. Y.) Fuel Gas Company.

We regret to report the death of Jno. R. Fenniman, late Superintendent of the Metropolitan Gas Light Company (Brooklyn, N. Y.), whose demise occurred on the 30th ult. Deceased, who was born in New York city, August 29, 1846, became attached to the staff of the Metropolitan Company on its organization in 1871, first serving as Assistant Supt. In 1876 he was promoted to the Superintendency, a post which he filled with credit to himself and with satisfaction to his superiors.

The Committee on Awards, of the Welsbach Incandescent Gas Light Company, Phila., Pa., appointed to decide as to who were entitled to the prizes for the best designs of shades and globes wherewith to tone down and mellow the light emitted from Dr. Auer's mantles, after due deliberation made the following decision: First prize ($150), to Tyndale Palmer, Phila.; 2d prize ($100), S. J. White, Chestnut Hill, Pa.; 3d prize ($75), G. A. Hyde, Jr., East Saginaw, Mich.; 4th prize ($50), Chas. Balderston, Phila.; 5th prize ($25), P. Lachenmeyer, Phila. The competition was a great success, 45 competitors having submitted 125 designs. It was, therefore, no mean triumph for Mr. Hyde to finish in third place, for some of those who made the running are acknowledged experts in this line of artistic work.

Mr. A. B. Beadle, Supt. of the Fall River (Mass.) Gas Works Company, is to take charge at Atlanta, Ga. He is a good man. Mr. Sheldon, formerly of the Lewiston (Me.) Company, succeeds Mr. Beadle at Fall River.

We understand that Mr. John P. Harbison has been elected to full membership in a prominent club whose headquarters are at Topeka, Kans. His election is said to have been unanimous. Mr. B. E. Chollar is also a member in good standing. Other Eastern candidates have been proposed. Maybe a Pine street (42) member will soon grace the lists.

It gives us pleasure to say that Mr. Stiness has recovered from his recent indisposition.

Capitalists are agitating the subject of organizing a gas company for Ridgedale, Tenn.

The Lenox (Mass.) Gas and Electric Company has been incorporated with a capital of $30,000. President, W. R. Plunkett; Treasurer, C. E. Morrill. This place is a post village of Berkshire county, Mass., is 8 miles south of Pittsfield, Mass., and about 33 miles southeast of Albany, N. Y. A venture of this sort ought to be profitable in this district; for, apart from the diversified manufacturing interests which are there centered, it contains many handsome residences.

The scheme which seeks to enlist the city of Milwaukee, Wis., in the business of operating a municipal electric lighting plant is much more comprehensive than such projects usually are—or have been. Ald. Baumgaertner, as the putative father of the bantling, asked that the city bond itself in the sum of $250,000 for the purpose of establishing a municipal incandescent electric lighting plant, to be used solely for lighting the streets and public buildings; but his demand was deemed altogether too modest by Ald. Brand (who eagerly seized the occasion to pose as its Godfather), the latter succeeding in securing the passage of a motion directing the City Attorney to draft the bill so as to provide for a "light service by the municipality in stores, factories, and residences," on the model of that which stands as the foundation of the city's water service.

Some time ago (last spring, in fact) we noted that the Lincoln (Neb.) Council was debating the propriety of creating the office of local gas inspector, and that the same body was engaged in an attempt to arbitrarily adjust gas rates. The result of the original attempt was so grossly unfair that the measure then concocted did not take root and flourish with that vigor which its promoters predicted, and it lapsed. The cool weather of late fall seems to have inspired them, however, to return to the charge, and the following is the outcome of their deliberations: The Inspector, who is to be appointed by the Mayor with the approval of the Council (he may at any time be removed by the same authority and process) is to receive a salary of $50 per month, with an additional allowance of $150 per annum "for the use and keeping of a horse and wagon." In return for these sums he is required "to examine and test each of the meters used for furnishing gas to the city, and also to test any gas meter in use by a private consumer, at the call of the latter, $1 to be paid in advance by such consumer, and such further sum, not exceeding $2, as may be necessary for each meter by him inspected." The fee goes to the city treasury, but is to be refunded to the consumer by the gas company when the Inspector's examination "shows the meter is found to register more gas than was actually consumed." The Inspector is also directed to see "that the contracts for city lighting are faithfully performed, that the street lamps are lighted promptly on time and kept burning during the required time, and that all lamps are kept in order." He is to "keep a record of all street lamps, and to make record of all complaints." It goes without saying that if Lincoln's Inspector makes due heed of all these duties, he will have earned his salary; and the horse will not have had a sinecure, either. The ordinance fixes the price of gas to private consumers at $2 per thousand cubic feet for illuminating and cooking purposes, but users of gas engines are to receive their supply at $1.75 per thousand.

In our last we had occasion to refer to certain practices which were seemingly fathered by the parent Westinghouse Company for incandescent electric illumination, and then instanced a peculiar trade at Binghamton, N. Y., as an illustration. Since then the public press has contained accounts of a deal at Evansville (Ind.) whereby the Evansville Gas and Electric Light Company was induced to part with some of its cash. We have waited in order to note whether the Westinghouse Company would deny these assertions, and failing to have seen such denial, we herewith reproduce a despatch sent to the Chicago *Inter-Ocean*, and printed by that paper in its issue of Nov. 25: "Evansville, Ind., Nov. 24.—The local sensation of the hour is the sell-out of the Citizens Electric Company to the Evansville Gas Company. The former, which controlled the Westinghouse patent, having been refused a franchise by the Council, were urging a mandamus in the courts to compel that body to grant them one. It has just transpired, however, that three of the leading promoters of the new Company have surrendered the contract to its rival, and received therefor $2,000, which they proposed to appropriate without consulting the rest of the stockholders." The parent Company might do well to say just where they stood in the matter.

Mr. C. M. Converse, well known throughout the West from his connection with the Delaware (Ohio) Gas Company, is now in charge of the Pomona (Cal.) Gas and Electric Company's plant. He is a competent and trustworthy gentleman, and Pomona is to be congratulated at his determination to become one of her business men.

One of the proprietors of the Troy (N. Y.) Gas Light Company, in noting the efforts now being made to consolidate the gas interests of that city, says: "The absorption of the Citizens Gas Company by an outside syndicate is said to be only the first advance towards gobbling up the Troy Gas Light Company. The question arises, can the outside corporation, by purchasing the property and franchise of the Citizens Gas Light Company, repudiate the agreement made between the Troy Gas Light Company and the former, when they divided the territory, each Company covenanting not to invade the territory of the other? The Common Council, it seems to me, should not allow the streets of the city to be dug up by a foreign corporation. I understand that Mayor Maher, of Albany, is interested in the syndicate that has purchased the Citizens Company stock. But we are selling gas cheaper than they sell it at Albany." The Albany syndicate may attempt to construe that Citizen franchise in a manner that, while it might serve their initial purpose fairly well, may act as a boomerang in the time to come.

THE Ross discharging machines at the Point Breeze station of the Philadelphia gas works have so worked on the feelings of the human stokers as to incite the latter to demand increased pay. These antics ought to be cordially hailed by Capt. Ross and his associates; for the dissatisfaction will give them opportunity to show how tractable and reliable their charging machines are. Verily, labor can always be counted on to harm itself most.

THE Hoosac Valley *News* man has been writing up Treasurer Frank S. Richardson's gas plant at North Adams, Mass., and the scribe man aged to do fairly well in his description. The purifying apparatus, however, seems to have been the only portion of the plant that stumped him—this department of the North Adams plant has been virtually reconstructed during the last summer. The newsgatherer having explained that the new purifying room was first visited, adds: "Here are located four great pans, resembling very much the old 'sap pan' used in making maple sugar, only very much larger, being 16 ft. square and 4½ ft. deep," and so on. From the article we gather the following particulars respecting the season's results in respect to the betterment of the North Adams works. The replacing of the old purifiers by the new set required an addition to the building equivalent to, say, 25 per cent., and an iron floor was put down. A new station meter (capacity 150,000 cubic feet in 24 hours) and an additional holder (35,000 cubic feet capacity) were also erected. The Company now has holder room for 85,000 cubic feet. The main system was also increased. These improvements entailed an expenditure of something short of $20,000, but the Company has acted wisely in making the investment, and Treasurer Richardson and Supt. Woodward rest content in that ease which accompanies security. In 1880 not quite 200 meters were in use in North Adams—the town then used no gas for street lighting purposes—whereas to-day 500 are in duty. In 1884 gas lamps (67 were ordered) appeared on the streets, which number has been augmented to the 104 of to day. The lamps, which burn all night and every night, are maintained at an annual charge of $25 each. The steady increase in output, as well as the no less satisfactory rate of decrease in the charge for the service, is illustrated in the following table—Company's year ends on July 1st:

Year.	Output.	Price per 1,000.
1880.....	4,500,000	$3.00 ....
1884.....	10,000,000	2.70—$2.50
1885.....	13,000,000	2.50— 2.35
1886.....	13,500,000	2.50— 2.25
1887.....	15,000,000	2.25— 2.15
1888.....	17,500,000	2.00 ....

The first dividend paid by the Company was declared in 1878, but the stockholders have since then received a fair return each year on their investment. All things in connection with the Company's management go to confirm that which we often said before about Treasurer Frank, who is at once a prudent, energetic and successful manager.

MANAGER WALTER A. BIXBY, of the Galena (Ills.) Gas Light Company, has also been putting his house in order. The plan of betterment now completed included the rehabilitation and enlargement of the carbonizing capacity (a new bench of 5's was added), the installation of an exhauster, the erection of a holder (41 ft. in diameter by 20 ft. in depth), and the placing of a street main governor. An extensive steam plant might also be named in completion of the betterment list. Thus equipped, Brother Bixby is ready and anxious to meet the demands of the residents for more light.

IT is presumed that Mayor Francis will, on receipt of the report of the St. Louis (Mo.) Gas Commission, forward to the General Assembly a message asking the Legislature to take appropriate steps in the matter of framing a law that shall enable the city of St. Louis to assume control of the local gas supply on and after Jan. 1, 1890. Councilman Blakely (who is a member of the special Commission that has for some months been considering this matter) seems to think that nothing will ultimately come out of this municipal scheme; and we must say that his view is shared by many well qualified to express an opinion about it.

THE following are the bids submitted to the authorities for the lighting of the Pittsburgh public districts respectively known as the East and West End, and the South Side, the awards to be made on the basis of a 3-year contract. Booth & Flinn (gasoline lamps) $17.39 each per annum; Wheeler Reflecting System, oil lamps, $14.48; gasoline lamps, $15.98; South Side Gas Company, $18.60 per post; Pennsylvania Globe Gas Lighting Company (gasoline lamps) $16.91; Fort Wayne Jenney Electric Light Company, 500 arcs (2,000-candle power), at $105 each per year; 300 (or less) arcs, $127 each; incandescent lamps (25-candle power), $16.50 each; 16 candle power lamps, $11.50 each; East End Light Company, $120 per lamp for 100 arcs (2,000-candle power), all in excess of the first hundred to be furnished at $100 each per annum; incandescent lamps (25-candle power), at $16 each; 16-candle power lamps to be furnished at $12 per lamp. In districts not reached by the lines of the last-named bidder the Company would maintain gasoline lamps for $12 per light. The bids were laid over, but the impression prevails that the East End Lighting Company will be given the contract.

MR. A. W. MCCAUSLAND has resigned his position as Manager of the Gardiner branch of the Kennebec (Me.) Light and Heat Company's electric plant.

BENJAMIN COOK, an employee of the Belfast (Me.) Gas Company, while filling a cask with hot tar the other day, lighted a match and applied it to the bunghole for the purpose of noting how far along he was in the operation. An explosion ensued. Cook, although not very badly injured, it is safe to say, will not try this method again.

AT a recent meeting of the Trustees of the town of Waterloo (N. Y.) four bids for lighting the streets were opened and read. Francis Boem proposed to supply 50 arcs (moontable plan of lighting) for the sum of $60 each per year, and his offer was accepted.

THE proprietors of the Amherst (Mass.) Gas Company are considering the advisability of engaging in the supply of electricity for light and power.

CAPITALISTS are agitating the formation of a Gas Company for Barre, Vt. The place is a very small one, and does not hold out any great promise of profit in the prosecution of such an undertaking.

AT a meeting of the Directors of the Burlington (Vt.) Gas Light Company, held on the 7th inst., it was decided to add an incandescent electric light plant to their present outfit. The work of installation will be proceeded with immediately.

THE special electric light committee of the Utica (N. Y.) Common Council has presented a very rabid report regarding the way in which the public electric lighting of that city is performed. Having noted that the city now pays for 365 arc lights, the report continues: "We have at last arrived at that point where we expect it will be necessary to order but few additional lights, if those now ordered are made to yield their proper candle power. As they are at present, we do not believe any of the city lamps are of 2,000-candle power, and if an average could be taken of the entire number of hours each light nightly burns, it would probably not exceed 1,000-candle power. The committee is unanimously of the opinion that the principal defect of the light is the frequency with which the lamps go out and remain out," [a trifle mystifying, this; for it looks from the text as if the Utica arcs are of the vagrant sort] "in some instances for long periods. This is a most objectionable fault, and may in many cases prove positively dangerous to life and property. As before stated we believe there will be necessity for but few additional lamps, provided those we have can be made to burn steadily and continuously. We would insist that the Company be compelled, under the penalty named in the contract, to make the lights satisfactory in those respects."

THE negotiations for the purchase of the Newton Electric Light and Power Company by the Newton and Watertown Gas Company have been consummated, and the new proprietors took possession on Dec. 1. The same force, with Mr. Cutler as Electrical Supt., will be retained, and the lighting service will continue as formerly, and at similar rates. Mr. W. A. Learned, the Gas Company's Supt., will, of course, be the responsible head of both branches of the Company's lighting service.

AT the north station of the Chicago Gas Light and Coke Company may be seen a station meter which is nearly if not quite 30 years old, and still actively engaged in work. This veteran is also a salamander, having passed through the fiery ordeal of 17 years ago. At the time of that disaster the meter was located in the Adams street plant, from whence it was removed to its present post—of course, it was thoroughly repaired. A very creditable record.

ACCORDING to City Comptroller Horner, Baltimore's public lighting bills for 1888 will figure out thus: Gas, $132,927.60; electric light (arc), $103,393.23; electric light (incandescent), $240. There are 579 arcs in use; the incandescent service consisting of 16 lamps, installed in the headquarters of fire engine No. 6.

THE large triple-lift holder ordered by the Laclede Gas Light Company, of St. Louis, Mo., from the Shickle, Harrison & Howard Iron Company, was turned over to the purchasers in a completed state on the very day named in the contract. The vessel was tested by Engineer Egner, who reports that it was found to be perfectly tight and is working well. This provision doubles the Laclede's storage capacity.

BUFFALO (N. Y.) is anxious to induce the Jenney Company (burned out at Fort Wayne, Ind., last month) to locate its new plant in that city.

SOME time ago we noted that Judge Tuley had issued a bill prohibiting the Metropolitan Gas Company from prosecuting the work of main laying within the limits of Hyde Park, a suburb of Chicago, from which judgment the Company took an appeal. Briefly related, the history of the case is this. The Metropolitan Company, in 1882, procured the passage, by the village Trustees, of an ordinance empowering it to lay pipes and construct gas works in the village for the purpose of supplying gas over the district, provided the sales rate should not exceed in gross $3 per thousand, the net rate to be 50 cents less. The ordinance (it was a most elastic one) allowed the Company 5 years in which to accept or reject the binding clauses. In 1883 the Company elected to proceed, and so notified the authorities. Its projectors purchased land for a site, but did not take title thereto for several months. Towards the close of '87 the work of building was commenced, and the Trustees offered no objection thereto until some $20,000 had been expended, when, without warning, the ordinance of '82 was repealed. Counsel advised the Company that the repealing act was invalid, and the former went on with its main laying. The Trustees thereupon ordered the Chief of Police to restrain the workmen, and the Company filed a bill to restrain the execution of said order. As said before, Judge Tuley decided against the Company, and the latter immediately instituted steps to have his decision reviewed in the Appellate Court. Judge Moran now reverses the finding of the lower court.

ANOTHER cause for rejoicing has been found by those who attend divine services in the Congregational Church at St. Johns, Mich., for gas has there taken the place of kerosene.

THE International Gas and Fuel Company has been incorporated in Chicago. Purpose, the manufacture of apparatus for the production of light and heat; incorporators, E. T. Williams, W. B. Wright, and J. E. McDowell; capital, $500,000.

WE are informed that the City Council of Elgin, Ills., has awarded to the Jenney Electric Light Company, of Indianapolis, Ind., a contract which commits the city to the purchase of an arc electric lighting outfit. The sum agreed upon is $15,525. The old lighting contract, made five years ago with the Elgin Electric Light Company, and to continue for five years, expired on Nov. 7. Those who invested in the stock of the Elgin Electric Light Company at the time of its formation, and who were largely influenced to make the investment by the promises of the authorities, now know how much such promises are worth. Mayor Price will undoubtedly veto the authorization; but as the measure received 10 affirmative votes to 3 against, there is little ground for thinking that his protest will not be overridden.

THE municipal electric lighting ring over in Brooklyn, N. Y., still continue to defy public opinion by their recklessness in ordering the location of new specimens of their 100 (one hundred) candle power arcs, paid for at the rate of $187.50 each per annum. The last order authorizes the lighting of Seventh avenue between Union street and the Greenwood Cemetery fence or railing. Come to think of it, why do they not try to gain a lodgment in the Cemetery itself? It would be just as reasonable to so light the resting places of the dead as it is to perform a similar service over that portion of Seventh avenue mentioned above.

Gas for Coal as Fuel.

Under this heading the Cincinnati *Commercial Gazette* (for December 9), publishes a most interesting article. We give it *in extenso:*

Recently there has been free and full discussion of the smoke and soot nuisance and of the method by which it can be abated. Among other solutions offered has been one to the effect that the desired result could be obtained by the substitution of gas for coal as fuel. General Hickenlooper is President of the Gas Company, and has been understood to have views on the subject. With a desire of obtaining these views a reporter, primed with questions, called upon the General yesterday afternoon, and here is the result:

"General Hickenlooper, I have called to obtain an expression of your views in regard to the feasibility of substituting gas for coal as a fuel in this city. Have you any objections to a little talk upon the subject?"

Certainly not. It will afford me pleasure to give you any information in my power, for there is no question of greater practical importance to the city of Cincinnati than that to which Mr. Halstead has called attention; and while the full measure of his desires in this direction may not be at once gratified, he has certainly blazed the way leading to one of the most important, and I may say inevitable, changes bound to come in our rapidly developing civilization.

"Have you any fixed convictions upon the subject, any views as to when or how it will be brought about?"

Yes, sir, I have. As President of the American Gas Light Association, I delivered the annual address in 1882, and in it said: "In this age of progress the controllers of such enterprises (gas companies) who halt or hesitate, if but for an hour, are left just that far behind the swelling tide; so if the 'old-time' manager whose chief boast is length, and not character, of service, has failed to note the progress of events, or aroused himself to a proper appreciation of the necessities of the hour, his days of usefulness are numbered, and the sooner he retires to the shades of private life the better it will be for the company he represents; for I firmly believe that the time is not far distant when public sentiment will demand, and engineering talent make possible, the delivery to consumers, in gaseous form, of at least one-half the fuel now used for domestic purposes. And it is not impossible that some of the gentlemen now present may live to see the day when gas—with its resultant coke—will be universally considered the cleanest, cheapest and most convenient fuel for manufacturing as well as domestic purposes, and raw coal be seen only at the mines or en route for the gas-works of the future."

"Well, do you think the happy time has come when we are to be thus blessed?"

Yes, we are now entering upon the new era, but all such changes are of slow but more or less certain growth, governed largely by collateral circumstances, the first being that gas must not only be cheap, but must seem cheap: that is, the people must be educated up to a realization and appreciation of its cheapness.

"Don't you believe that the 'proof of the pudding is in the eating,' and that whenever it is so it will appear so?"

What I mean by that is this: there has been a good deal of agitation of the subject of cheap fuel gas, and claims have been made that such a gas could be made and delivered at forty-five cents per thousand cubic feet; now the public felt that this would be a consummation devoutly to be wished, never realizing that they already have at their doors and in their houses a gas that for heating purposes is less expensive than that would be, and which, because of its concentrated form, can be transported and delivered at less expense.

That is, the most thorough scientific research has established the fact that the comparative number of pounds of water which an equal volume of each will evaporate within a given time is as follows:

Illuminating coal gas	18.80
Uncarburetted water gas	7.60
Generator or fuel gas	2.90

That is, our Cincinnati gas possesses 2.48 times the number of heat units that the very best uncarburetted water gas does, and 6½ times the number contained in generator or fuel gas. So that Cincinnati gas is now as cheap for heating purposes as water gas would be at 46 cents per thousand cubic feet, or fuel gas at 18 cents per thousand.

In fact we are, through the instrumentality of the Bunsen burner, attached to the modern gas stove (which mixes six parts of air with one part of the illuminating gas) now delivering fuel gas at an equivalent of 16½ cents per thousand.

"You do not then believe there would be any pecuniary advantage to be derived from the manufacture of a non-illuminating gas?"

I do not believe that any gas which will be suitable for heating alone can be made and delivered for an equivalent of the price at which illuminating gas is now being delivered in this city, for the simple reason that much of the cost of gas is in the delivery expense, and as you increase the bulk, you must correspondingly increase the size and cost of mains, services and meters.

"Do you not think that if the price of gas was still lower than it is, it would largely increase its use for heating and manufacturing purposes?"

Yes, I do; but this will come in the course of time. While the charge for gas in this city is now very low, I expect to live to see the day when it will be much lower; for as consumption increases the expenses are proportionately less, and profit proportionately greater. This is the cause of cheap gas in London; when the patronage was devided up between a dozen different companies the price was twice what it is in this city to-day. Now that

the gas to that great metropolis is made by but two companies sending out 100 times the volume we do they can afford to sell it at a much less price.

If the supply of gas to the city of New York, in place of being supplied by a half dozen different companies, could be consolidated under one management, they could sell gas at 25 per cent less, and make 25 per cent more profit than they now do. In other words, the revolution will be brought about by a sort of reciprocating action; the recent reduction will cause an increased use of gas, this will in turn enable the gas company to again reduce, and such reduction will induce a still more liberal consumption, and so it will go until, as I stated, "raw coal will be seen only at the mines or en route for the gas-works of the future."

"Have you ever estimated what the practical results would be if an ordinary sized family should use gas for all purposes required by their domestic requirements?"

Yes, I have figured a little on that, and in the absence of actual practical experience (my estimate has only a theoretical basis) I am confident will not be much out of the way.

An ordinary sized family will consume about 400 bushels of coal per year, and its cost, coupled with the expense of storing, handling, kindling and removal of ashes, will amount to $78.

Now, let us estimate what the same family could get for this amount of money if expended for gas:

For one gas cooking stove, in use three times a day, $2 48 per month	$29 20
Reflector stove in dining-room, three hours per day for six months, $1 39 per month	8 34
Fire-place heater for sitting-room, in constant use for fifteen hours per day for two months, half full volume for two months and an average of six hours per day for three additional months	27 94
Gas log in parlor, two evenings per week for three months	1 65
Reflector in bath-room, twice a week for four months	2 57
Reflector in two bedrooms, one hour morning and one hour evening for six months	8 28
Total	$77 98

"This estimate applies only to its use for household purposes. Have you ever thought it practicable to utilize it for manufacturing purposes?"

Under existing conditions the advantages and economies of gaseous fuel are much more apparent for domestic than for manufacturing purposes, because the existing system of using coal in the manufactories throughout the country is a great improvement over that in vogue a few years ago; study and experiment have provided new and better styles of boilers and improved furnaces, greatly increasing the efficiency per pound of fuel used, enabling them to get out about all there is in it.

For the development of power in manufacturing operations, the maximum efficiency of gas is best utilized through the operation of a gas engine.

It requires no engineer or fireman, can be started in an instant, and be stopped as quickly, when the cost of its operation at once ceases, making it very decidedly the cheapest power now known, when the generation of steam is not reqired for other purposes. But for domestic purposes the systems are still grossly defective and wastful, generally utilizing not to exceed one-eighth the maximum heat units in a pound of coal.

"Are there any incidental advantages arising from the use of gas in preference to the use of coal for domestic purposes; that is, any that would in a measure compensate for what might prove to be an excess of cost?"

Yes, sir; the use of gaseous fuel saves domestic labor to such an extent that many housekeepers who desire to economize would be enabled to dispense with one servant whose presence is now a necessity because of the laborious character of the services required; in fact, the mistress of the house will find it less laborious and pleasanter to prepare the meals herself with a gas stove than supervise, direct and control the autocrat of the range.

Better cooked food at less expense can be prepared by gas than in any other way. In fact, the most noted restaurateur in the country, H. M. Kinsley, uses nothing but gas in his world-famed restaurant at Chicago, and last year sent this dispatch to Ferd Fere, President of the French Culinary Society:

"I congratulate you on your success in cooking by gas. After an experience of five years I say positively there is no process equal to it. It produces results in every detail never before accomplished—quick action, economy, convenience and comfort are all combined.

"I firmly believe it to be the fuel of the near future for all culinary purposes. "H. M. Kinsley."

Why, the saving in weight of meats, the avoidance of scorching, drying and waste incident to the use of a coal fire, which can not be perfectly regulated, will more than pay for the gas used.

"This latter statement is rather a remarkable one. Have you any facts bearing upon the point?"

Yes, sir; here on page 22 of this pamphlet, you will find a statement of the experiments made at the London Hospital, where it was found that meats roasted by coal fires lost one-third of their weight, while meats roasted by gas lost but fourteen per cent., or one-seventh of their weight, and in addition were found to be more full of nutritive elements than when cooked in the old way, the juice and fat being no longer separated but thoroughly incorporated with the meat.

Here are also the figures of an experiment made at the New York Hospital, in which it is shown that two joints weighing sixteen pounds each, were used; one on being cooked by coal fire, lost five pounds, and the other cooked by gas, lost but three pounds, a difference of two pounds, which saving was greater than the cost of the gas used. I am aware that these are very striking figures, but are only a confirmation of several such tests, some of which have been made at our own Cincinnati Hospital, where they have found the saving great enough to warrant them in first making the gas from coal and then using it for cooking and laundry purposes. There is no question that the saving in substance is alone sufficient to defray the entire expense of the gas used; or, as compared with the present wasteful method of coal fires, demonstrates that so far as meats are concerned you can not only cook for nothing, but can make money by the operation.

"How about heating houses, substantially as they are now heated by an ordinary house furnace?"

I do not believe there have been any advances made in that direction in this country. Mechanics and inventors have not yet realized the revolution that is going on, and the growing importance of some mechanical construction peculiarly adapted to this purpose. When in London I saw in the corner of a basement room a neatly incased radiator heated by gas and governed by a thermostat regulator, which furnished warm air fresher and purer than could be obtained by the very best furnace ever invented, and the owner informed me that he simply lighted the jets in the fall, and the regulator so perfectly controlled the supply that it automatically preserved a uniform and equitable temperature throughout the entire season, and thus avoided the necessity for any personal attention or the maintenance of all-night furnace or grate fires.

"I suppose when gas is more generally used it will also have a material effect upon the appearance of our city, will it not?"

Yes, sir; you may confidently look in this direction for a solution of the vexed problem of the soot and smoke nuisance. Manufacturers can be looked after and be compelled by law to adopt some of the numerous devices for the more perfect combustion of solid fuel; but the greatest damage is done by the thousands of dwelling-house chimneys in the residence portion of our city, each contributing its mite to the general destruction of clothing, carpets, books, drygoods, and household furniture, the aggregate of which has been estimated by experts to be greater than the total value of the fuel used. I tell you the people of this country are just beginning to appreciate the manifold blessings about to be showered upon them by the much abused and maligned gas companies.

I have no doubt that the citizens of this soot-begrimed city will some day rise up in their might and demand the erection of monuments to commemorate their appreciation of the invaluable services rendered by this Company.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

"W." Coincides with Mr. Somerville.

NEW YORK, Dec. 10, 1888.

To the Editor AMERICAN GAS LIGHT JOURNAL:

In your issue of November 16 your correspondent "W. M." condemns Mr. Somerville's position in regard to the so-called "Self-Sealing Lids."

From the language used by "W. M." I should judge that either he has a patent lid for sale, or is in some other way interested in their introduction, and is not engaged in using lids of any kind, for he could not have written the article in question from his own experience in using "Self-Sealing Lids," *so-called*.

Mr. Somerville's experiences with these lids are not a "surprise to the great majority (of gas men) who have used them;" for a large majority of gas men who have used these patent lids quite agree with what Mr. Somerville has to say about them.

I have used many kinds of patent lids in the works of which I am the Superintendent, and at the present time am using two different kinds. From my experience I fully indorse what Mr. Somerville has to say about their impracticability. In their use we found that, with a light charge of coal in the retorts, the patent lid would hold the gas fairly well; but with our ordinary charges of, say, 300 pounds of coal per retort the self-sealing lid will not close gas and tar tight.

These facts, together with the constant attention and expense required to clean and repair these lids, lead Mr. Somerville and others, as well as myself, to condemn the self-sealing lids now in use as impracticable.

Let "W. M." give us something better and we will purchase from him.

W.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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MONDAY, DEC. 17, 1888.

The Market for Gas Securities.

During the fortnight Consolidated maintained its own in rather striking contrast to the general share list, which, save in respect to one or two specialties, the manipulators whereof, being urged by special reason to save their particular pets for the time being from sinking to their intrinsic value, at one time looked little short of panicky. From to-day on the process of distributing the dividend checks for the last half year will be the portion of the Company's Treasurer. It is, of course, somewhat early in the season to start guessing as to the rate of the return for the first six months of '89; but holders may rest assured that that return will not be less than 2½ per cent. With this understanding, Consolidated at or below 80 is a financial gem.

Equitable hardens in value, and the Company, it cannot be gainsaid, constantly betters its position. Mutual is a trifle weaker, but the depression is without cause.

Brooklyn shares are advancing, and those who acted on the hint in our last to absorb either old Brooklyn or Nassau ought to be satisfied. The jump in Nassau (10 points in the bid price within a fortnight) speaks for the wisdom of such a transaction. The plant betterment instituted by the advice of Col. Benson will be worth many a dollar to the Company this winter.

Gas proprietors, as a rule, seem disposed to work along on very close lines. and the Col.'s Directors, always excepting the shrewd President of the Company, prove no exception to the general run. He, therefore, should be awarded a double measure of credit—one for his good engineering, and the other for his pertinacity in punching his superiors to the point of authorizing the necessary expenditure; even though the latter involved a good round sum.

The Boston situation, viewed through the spectacles of the Bay State combination, once more assumes a roseate hue. The defenders of the latter assert that it is now but a question of short time when English capital will have led them out of the wilderness. We are told that nine millions of dollars have been all but pledged wherewith to complete the scheme of purchase and amalgamation of all the companies now doing business in Boston. On the other hand other operators, unidentified with either faction, just as strongly affirm that the old Boston Company will maintain its position; some in fact going so far as to say that eventually the old Company will be the absorber, and not the absorbed.

The Stock Exchange listing committe has assented to the listing of the following named securities: Chicago Trust stock, $25,000,000; Chicago Gas Light and Coke Company, 1st mortgage bonds, guaranteed 5's, $7,650,000; Peoples Gas Company, Chicago, 1st mortgage, guaranteed 6's, $2,100,000; same Company, 2d mortgage, guaranteed 6's, 2,500,000; Equitable Gas and Fuel Company (Chicago), 1st mortgage, guaranteed 6's, $2,000,000. The St. Louis situation, as far as the result of the labor of the Special Commission—appointed some time ago to determine whether or not the city should lease and operate (after 1890) the various local plants—is concerned, amounts to naught in the item of possible change. The Companies (if consolidated eventually) will not come under municipal control.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

DECEMBER 17.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	78½	79½x
Central	440,000	50	—	60
" Scrip	220,000	—	47	57
Equitable	4,000,000	100	115	120
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	115	118
Mutual	3,500,000	100	97	99
" Bonds	1,500,000	1000	100	102
Municipal, Bonds	750,000		—	—
Northern	125,000	50	30	—
" Scrip	108,000			
Yonkers		50	90	100
Richmond Co., S. I.	300,000	50	55	60
" Bonds	12,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	103	105
Citizens	1,200,000	20	52	55
" S. F. Bonds	320,000	1000	—	103
Fulton Municipal	3,000,000	100	130	133
" Bonds	300,000		—	106
Peoples	1,000,000	10	74	75
" Bonds (5's)	368,000	—	97	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	87	90
Nassau	1,000,000	25	110	—
" Ctfs	700,000	1000	100	103
Williamsburgh	1,000,000	50	124	125
" Bonds	1,000,000	—	111	112
Out of Town Gas Companies.				
Boston (Mass.) Gas Co	2,500,000	500	200	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	—	—
" " Bonds	45,000	—	—	—
Chicago Gas Trust	25,000,000	100	34¾	35½
Cincinnati G. & C. Co.	6,000,000	100	187½	188¾
Consumers Toronto	1,000,000	50	192	—
Central, S. F., Cal.			—	90
Capital, Sacramento, Cal.			58	—
Consolidated, Balt.	11,000,000	100	47½	48
" Bonds	6,400,000		107	107½
Hartford, Conn	750,000	25	—	138
Jersey City	750,000	20	165	170
Laclede, St. Louis, Mo.	2,000,000	100	115	117
Louisville, Ky	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	207	—
Memphis (Tenn.) Gas	750,000	100	48	51
" Bonds.	240,000	100	103	—
New Haven, Conn		25	193	197
Oakland, Cal.			33	33½
Peoples, Jersey City		—	60	61
" " Bonds			—	—
Paterson, N. J.		25	90	—
Rochester, N. Y.		50	75	80
Syracuse, N. Y.	500,000	25	—	—

Advertisers Index.

GAS ENGINEERS. Page

Jos. R. Thomas, New York City 444
Wm. Henry White, New York City 438
Wm. Mooney, New York City 444
William Gardner, Pittsburgh, Pa. 444
Fred. Bredel, N. Y. City 443

PROCESSES.

National Gas Light and Fuel Co., Chicago, Ills. 438
American Gas Improvement Co., Pittsburgh, Pa 437
Bartlett, Hayward & Co., Baltimore, Md 435
Wm. Henry White, N. Y. City 438
United Gas Improvement Co., Phila., Pa 437
Henry Pratt & Co., Chicago, Ill. 446

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City 447
T. F. Rowland, Greenpoint, L. I. 447
Delly & Fowler, Phila., Pa. 447
Kerr Murray Mfg. Co., Fort Wayne, Ind 446
Stacey Mfg. Co., Cincinnati, Ohio 447
Bartlett, Hayward & Co., Baltimore, Md 435
Morris, Tasker & Co., Limited, Phila., Pa 433
Davis & Farnum Mfg. Co., Waltham, Mass 409
R. D. Wood & Co., Phila., Pa 446
Bouton Foundry Co., Chicago, Ills 447
Smith & Sayre Manufacturing Co., New Yotk City 447
Fred. Bredel, N. Y. City 443
United Gas Improvement Co., Phila., Pa 437
Henry Pratt & Co., Chicago, Ill. 446
National Gas Light and Fuel Co., Chicago, Ills 438

GAS AND WATER PIPES.

Gloucester Iron Works, Phila., Pa 444
Mellert Foundry and Machine Co., Reading, Pa. (John Fox, Selling Agent, N. Y.) 444
Ohio Pipe Co., Columbus, Ohio 441
M. J. Drummond, New York City 444
Wells Rustless Iron Co., New York City 444
R. D. Wood & Co., Phila., Pa 444
Warren Foundry & Machine Co., New York City 444
Donaldson Iron Co., Emaus, Pa 441
Dennis Long & Company, Louisville, Ky 444

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J 442
B. Kreischer & Sons, New York City 442
Adam Weber, New York City 442
Laclede Fire Brick Works, St. Louis, Mo 442
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y. 442
Borgner & O'Brien, Phila., Pa 442
James Gardner, Jr., Pittsburgh, Pa 442
Henry Maurer & Son, New York city 443
Chicago Retort and Fire Brick Co., Chicago, Ills 443
Baltimore Retort and Fire Brick Co., Baltimore 442
Oakhill Gas Retort and Fire Brick Co., St. Louis, Mo 442
Emil Lenz, New York City 442

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md 435
Fred. Bredel, New York City 443
Chicago Retort and Firebrick Co., Chicago, Ills 443
H. C. Hann, Baltimore, Md 438
Wm. Henry White, N. Y. City 438

PURIFYING MATERIAL.

Connelly & Co., New York City 439
Friedrich Lux, London, England 433

SCRUBBERS AND CONDENSERS.

G. Shepard Page, New York City 436
R. D. Wood & Co., Phila., Pa 446

GAS GOVERNORS.

Connelly & Co., New York City 439
R. K. Huntoon, Franklin, Mass 433
Fred. Bredel, N. Y. City 443
Friedrich Lux, London, England 433

TAR AND CARBONIC ACID EXTRACTOR.

Geo. Shepard Page, N. Y. City 400

CEMENTS.

C. L. Gerould & Co., Brooklyn, N. Y 442
H. W. Johns Manufacturing Co., N. Y. City 434

GAS ENRICHERS.

Standard Oil Co., Cleveland, Ohio 448

GAS METERS.

Harris, Griffin & Co., Phila., Pa 450
American Meter Co., New York and Philadelphia 451
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa 451
Helme & McIlhenny, Phila., Pa 451
D. McDonald & Co. Albany, N. Y 451
Nathaniel Tufts, Boston, Mass 450
Maryland Meter and Manufacturing Co., Baltimore, Md 450

EXHAUSTERS.

P H. & F. M. Roots, Connersville, Ind 445
Smith & Sayre Manufacturing Co., New York City 447
Wilbraham Bros., Philadelphia, Pa 439
Connelly & Co., New York City 439

GAS COALS.

Penn Gas Coal Co., Phila., Pa 449
Perkins & Co., New York City 448
Newburgh Orrel Coal Co., Baltimore Md 449
Despard Coal Co., Baltimore, Md 449
Chesapeake and Ohio R.R. Coal Agency, N. Y. City 449
Westmoreland Coal Company, Phila., Pa 449
Monongahela & Peters Creek Gas Coal Co., Pittsburgh, Pa 449
Cannelville Coal and Iron Co., Chicago, Ills 449

CANNEL COALS.

Perkins & Co., New York City 448
J. & W. Wood, New York City 448

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y 440
John McLean, New York City 440
Chapman Valve Manufacturing Co., Boston, Mass 440
R. D. Wood & Co., Phila., Pa 446

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa 452
Clerk Gas Engine Co, Phila., Pa 440

ENGINES AND BOILERS.

Jarvis Engineering Co., Boston, Mass 439
Ball Engine Co, Erie, Pa 433

GAS LAMPS.

The Siemens-Lungren Co., Philadelphia, Pa 445
G. Shepard Page, New York City 404
Albo-Carbon Light Co., Newark, N. J 439
Standard Gas Lamp Co., Phila., Pa 434
U. S. Wenham Pat. Gas Lamp Co., New York City 361

PURIFIER SCREENS.

John Cabot, New York City 440
Geo. A. Mills, Baltimore, Md 440

GAS STOVES.

American Meter Co., New York and Philadelphia 441
The Goodwin Gas Stove and Meter Co., Phila. Pa 416

STREET LAMPS.

J. G. Miner, Morrisania, New York City 434
Bartlett Street Lamp Mf'g Co., New York City 434

BURNERS.

C. A. Gefroner, Phila., Pa 448

STEAM BLOWER FOR BURNING BREESE.

H. E. Parson, New York City 440

GASHOLDER TANKS.

W. C. Whyte, New York City 435

GASHOLDER PAINT.

H. W. Johns Manufacturing Co., N. Y. City 434

COKE CRUSHER.

C. M. Keller, Columbus, Ind 449

ELECTRICAL APPARATUS.

Waterhouse Electric & Manufg Co., Hartford, Conn 434
Wm. Henry White, N. Y. City 438

BOOKS, ETC.

Goodwin's Directory of Gas Light Companies 443
King's Treatise 444
Scientific Books 450
Management of Small Gas Works 440
Gas vs. Electricity 442
Practical Electric Lighting 439
Electric Light Primer 439
American Gas Engineer and Superintendents' Handbook 433

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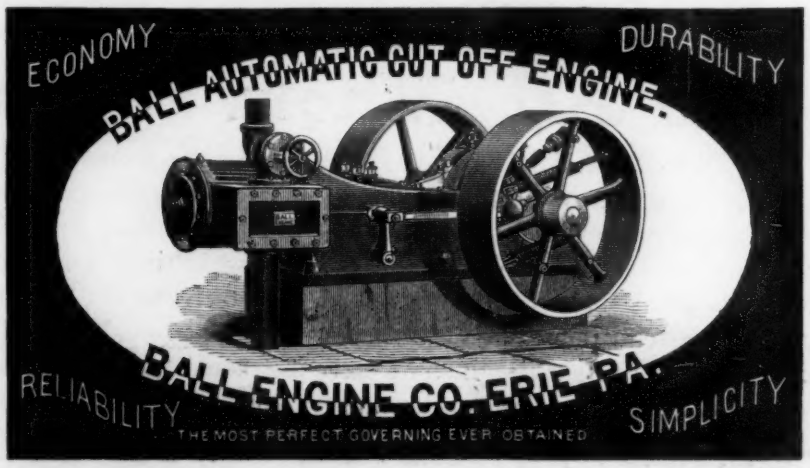

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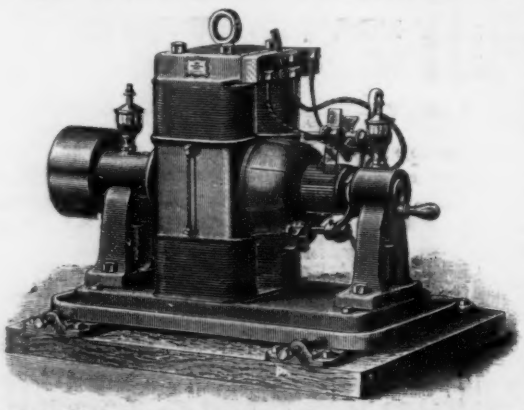

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WILLIMANTIC, CONN., Nov. 5, 1888.

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The SIEMENS-LUNGREN COMPANY hereby warns the public against the use of various infringing Regenerative Gas Lamps which are offered for sale. This Company has heretofore delayed bringing suit to enjoin the manufacture or importation of such infringing lamps, solely because of the practical worthlessness of the infringing devices; and although, in each instance, they infringe some one or more of the various patents owned or controlled by this Company, they have fallen into disuse sooner than any suit could be brought to a hearing. As, however, the introduction of these infringing lamps has tended to discredit the practicability of our Company's system of regenerative gas lighting, we have instructed our Attorneys, Messrs. Geo. Harding, C. S. Whitman, and Silas W. Pettit, to give notice that legal proceedings will in future be taken against all such infringers

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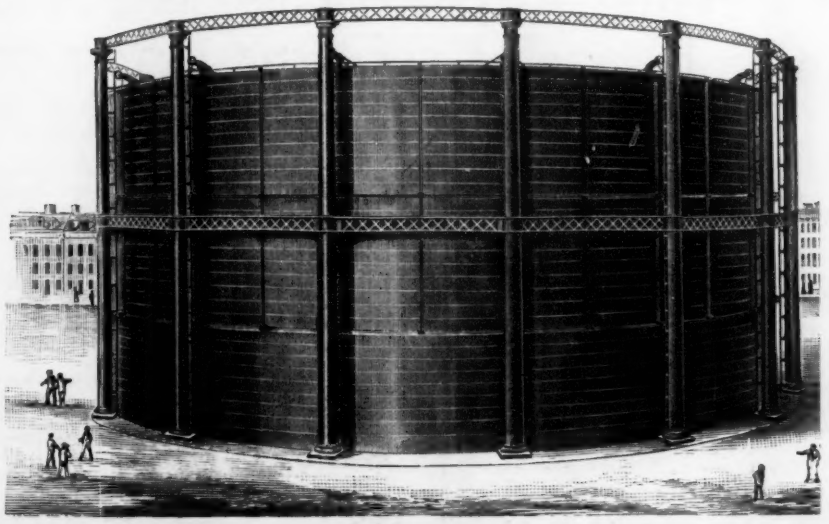

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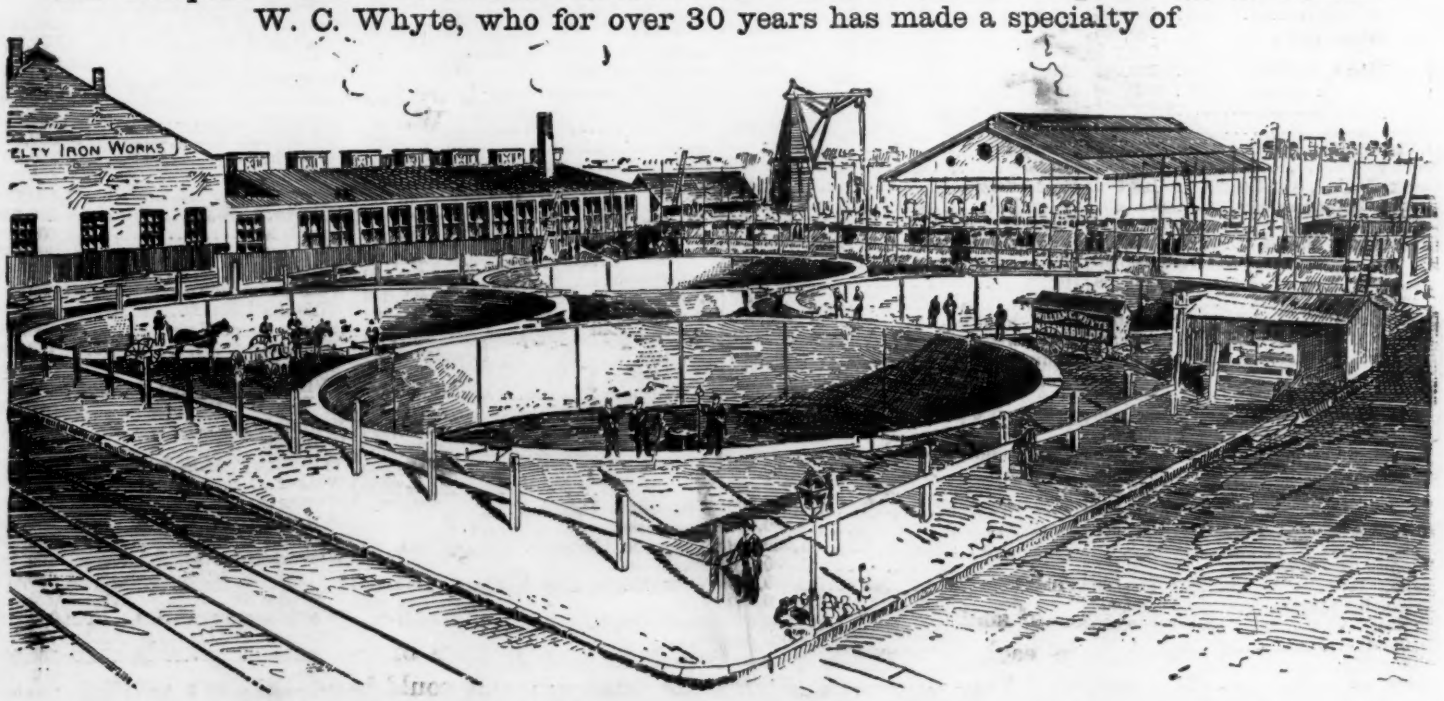

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Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
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"	1,250,000
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"	1,000,000
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Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co	20,000
"	20,000
Bombay	400,000
Buffalo, U.S.A., Mutual	750,000
" **Citizen**	500,000
Brookline, U.S.A.	500,000
Bergen	350,000
Berlin	1,250,000
Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A.	1,000,000
"	1,000,000
" **Nassau**	1,000,000
Brunner, Mond & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A.	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A.	350,000
Denver, "	500,000
" "	1,000,000
Dusselldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A	750,000
Magdeburg	300,000
Memphis, U. S. A	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A.	430,000
Newmarket	150,000
Newark, U.S.A	680,000
Northfleet	200,000
New York, U.S.A	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W.	100,000
Prescott	150,000
Providence, U.S.A.	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W.	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S A	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A.	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A	750,000
Yeadon	500,000
Yeovil	250,000

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Bucyrus Gas Light and Fuel Co.	Bucyrus, Ohio.
Morris Gas Co.	Morris, Ill.
Los Angeles Gas Co.	Los Angeles, Cal.
San Diego Gas Fuel and Electric Lt. Co.	San Diego, Cal.
Jackson National Gas Co.	Jackson, Mich.
Sioux Falls Gas Co.	Sioux Falls, Dak.
Dakota Gas and Fuel Co.	Grand Forks, Dak.
St. Johns Mutual Gas Co.	St. Johns, Mich.
Stillwater Gas Light Co.	Stillwater, Minn.
St. Paul Gas Light Co.	St. Paul, Minn.
Emporia Electric and Gas Light Co.	Emporia, Kas.
Van Wert Gas Light Co.	Van Wert, Ohio.
Lansing Gas Light Co.	Lansing, Mich.
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Shelbyville Gas Light Co.	Shelbyville, Ind.
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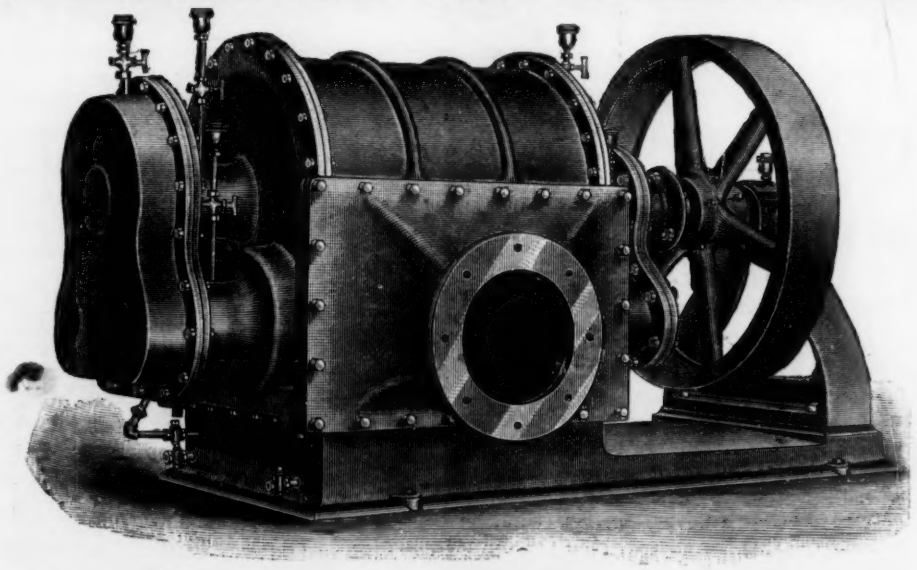

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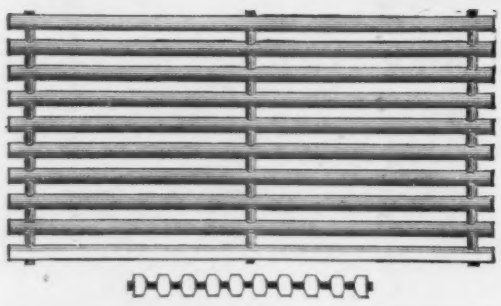

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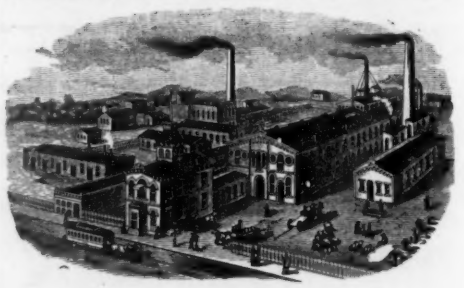

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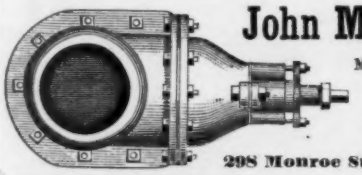

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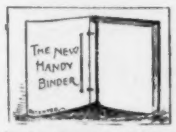

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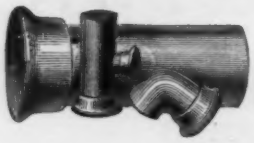

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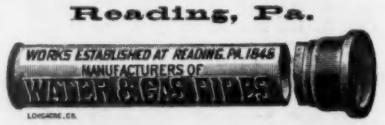

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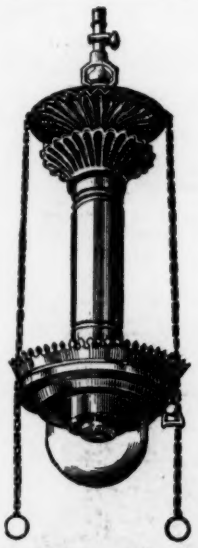

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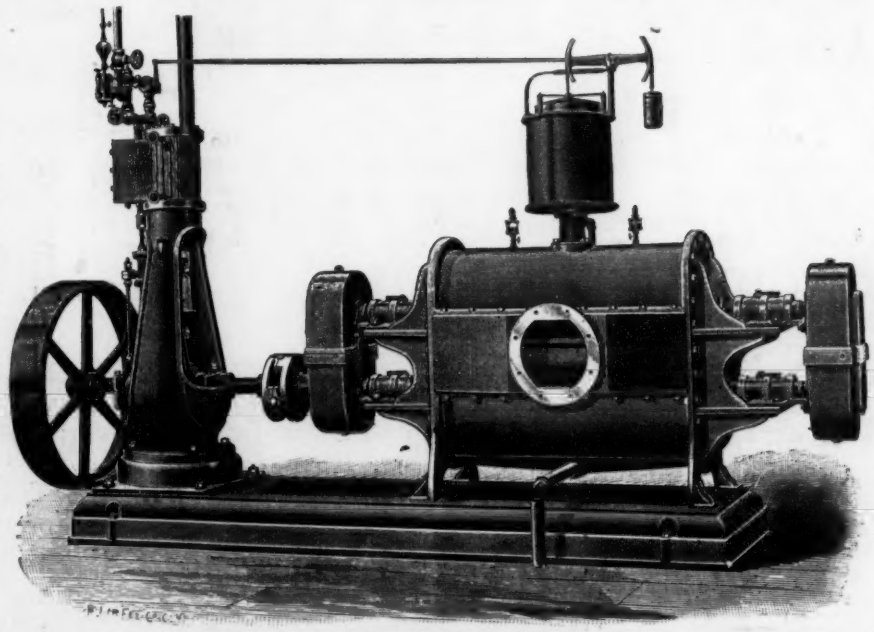

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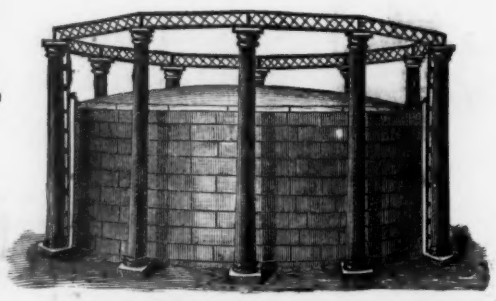

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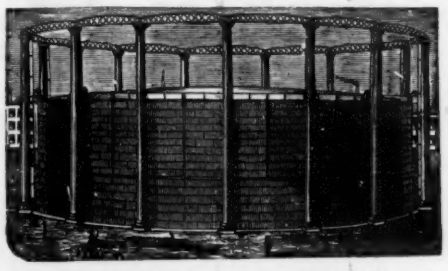

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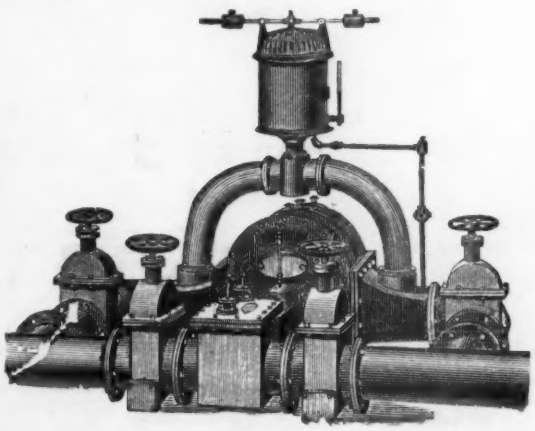

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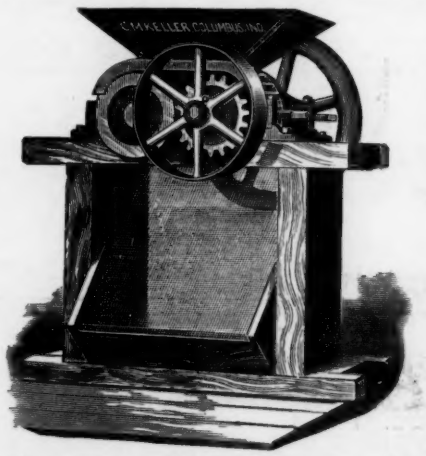

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50-H.P. STEAM ENGINE AND BOILER, Running a Plant of Fifty 2000-C.P. Arc Lamps 12 Hours.	
4,500 lbs. Indiana nut and slack, at $1.30 per ton	$2 93
Engineer, one night, at $50 per month	1 67
Trimmer, one day, at $40 per month	1 33
Superintendent or Electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent, one day, at $40 per year	11
Wheeling coal and removing ashes, at $4 per week	58
100 pairs carbons, at $18.50 per 1000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$10 38

50-H.P. OTTO GAS ENGINE, Running a Plant of Fifty 2000-C.P. Arc Lamps 12 Hours.	
9,200 cu. ft. gas, at 42 cts. per M. (for cost of gas see items below)	$3 86
Engineer not needed; engine is in care of Electrician or Supt.	....
Trimmer, one day, at $40 per month	1 33
Superintendent or electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent dispensed with (cooling water used over and over)	....
Handling of coal included in cost of gas	....
100 pairs carbons, at $18.50 per 1,000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$8 95

Expenses of depreciation, repairs, and interest omitted, being considered the same in both cases—though depreciation and repairs are much higher with steam on account of boiler and its appurtenances. Cost of gas in the holder we estimate for most of the Middle and Western States as follows: Coal, 30 cts.; labor, 20 cts.; purification, 2 cts.; total, 52 cts. Less coke, 7 cts., and tar, 3 cts.; leaving net cost of gas 42 cts. The items of Superintendence and repairs, being paid for by the gas sold to consumers, need not be charged on extra output for gas engine consumption. Where the cost of gas is higher than here figured, coal for steam use will be found proportionally higher, and final figures of comparison show same amount of saving.

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